

ant among giants...a fable

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Abstract

The Foundational Questions Institute has invited all creatures great and small to opine on what is ultimately possible in physics. While many things can be proved impossible, to say what is ultimately possible would seem to involve more than a little prophecy. Most people are extremely bad at prophecy. You might as well ask an ant. Here is a fable about an ant who dabbled in physics and metaphysics.

Once upon a time there was an ant who, having no interest in the mindless life of your typical ant, began to wonder what else there was. Soon it realized that the universe was very large and diverse, and yet no one seemed to know how it came to be or what its purpose was. The ant found this hugely fascinating, and so it resolved to think about nothing else until it had found the answers.

Noticing that there were certain giant creatures called physicists and philosophers whose occupation it was to seek the same answers, the ant began to study these disciplines, especially physics. One day, while thinking about the nature of time, the ant realized that there is no time without change, and that change is not perceived unless a new concept is created. Suddenly it saw an enormous starburst of concepts, beginning with the most basic concept, existence, and expanding without limit. This vision made a huge impression on the little creature. By now it knew some physics, and it realized that it was probably seeing the big bang. Could the universe be an expanding consciousness, and if so, how did the physical universe come to be?

Fast forward now to a time some forty-plus years later. Our ant was pretty old by then (most ants live less than ten years.), but it was certain that it had the answers. Meanwhile, the giants were still looking, the physicists loudly lamenting their lack of progress in many areas for the last thirty years or so. The ant had summarized its answers in a pair of papers, one on physics and one on metaphysics. It had published both on the internet and its physics paper had been published in a peer-reviewed journal, all without any indication that even a single giant had seen them. More than once, it had responded directly to a giant who had publicly expressed a desire for some answer or other, but as you might predict, no one, especially a giant, ever takes anything seriously that any ant has to say about anything, especially physics. It didn't help that reality turns out to be

inherently paradoxical and doesn't make sense to conventional ways of thinking, which explains why no one has found the answers in the many thousands of years that humans have been searching for them. The ant found its chilly reception perfectly proper and understandable, but always experienced a feeling of frustration when some giant publicly expressed ignorance on a question to which the ant thought it had the answer.

It was obvious that the physicists were befuddled. Charged with finding out what the universe is all about, they didn't have a clue. To be fair, they did know a lot. The standard model of elementary particle physics was a great success, and they had recently made many exciting cosmological discoveries. Yet the ultimate answers eluded them.

In the summer of 2004, the ant was crawling around during the SLAC Summer Institute at Stanford University. The theme was "Nature's Greatest Puzzles." Two of the speakers at the Institute, acknowledging the lack of progress towards answers, asked the same question: "What are we missing?" Of course, they didn't know, but one thought it might be a basic principle, like Einstein's constant speed of light, that isn't obvious but once acknowledged would open up new ways of thinking, leading to new truths. The year 2005 was the 100th anniversary of Einstein's "miraculous" year in which he published several breakthrough papers, and articles about him were appearing frequently in the media. Lee Smolin of the Perimeter Institute for Theoretical Physics wrote in *Physics Today* (January 2006) that he receives calls from journalists asking, "Why is there no new Einstein?" His answer is that we should identify brilliant young physicists and give them a lot of freedom to explore areas outside the established large research programs. In his book, "The Trouble with Physics," Smolin opines that there are two kinds of physicists, seers and craftspeople, and it is the inability of the majority of physicists to recognize, support, and listen to seers that has led to the current lack of progress. In truth, there simply were no seers.

At that time, most of the energy of the theoretical physics community was focused on the search for a theory of quantum gravity, a unification of quantum field theory and Einstein's general relativity. The two main research programs were string theory and loop quantum gravity, neither of which had gotten very far in spite of many years of effort. The mathematician John Baez of the University of California at Riverside was heavily involved with loop quantum gravity. He was writing an online column about whatever interested him at the moment, and in his column of August 25, 2005 he wrote, "Work on quantum gravity has seemed stagnant and stuck for the last couple of years, which is why I've been turning more towards pure math." He went on to say, "There's still tons of beautiful math coming out of string theory, mind you: right now I'm just talking about physics."

To the ant's way of thinking, that summed up one of the main reasons why progress in physics seemed so hard to come by. The theoretical physicists were all doing pure mathematics, not physics. They had been led down this path by the great successes of the standard model, which were achieved mainly through pure mathematics. By applying symmetry principles, theorists concluded that the electromagnetic, weak, and strong forces had to be transmitted by certain gauge particles, most of which were quickly found

by experimentalists. As a result, theorists were by and large convinced that this was the only approach that was likely to lead to further successes, especially the sought-after theory of quantum gravity. The mathematics they depended on consisted of quantum field theory and general relativity. “Mathematics is the language of physics,” they were fond of saying, so everything must be expressed in terms of quantum field theory and general relativity. A reality that could not be so expressed would be impossible for them to find. Almost every new idea consisted of adding a scalar field or two to some existing model. Not one of these scalar fields was ever identified with any physical phenomenon, which ought to be what physics is all about. In other words, the physicists were ensnared in a dense thicket of mathematics, desperately trying to get out by going deeper into the thicket. Only the string theorists thought they had hacked their way out of the thicket, but what they found was a vast landscape of universes that had no predictive power and couldn’t be tested—the end of science.

Was anyone doing physics? One could find hundreds of amateurs, wannabe physicists, on the Internet. They had in common that they hadn’t studied the abstract mathematics of physics and so were forced to come up with physical models for observed phenomena. The ant considered itself one of them, although it found the work of most to be off the mark. Too many were trying to prove that the mainstream physicists had it all wrong. In fact, they had it spectacularly right, but had been led into a dead-end street by their own success. But being a brilliant mathematician is neither necessary nor sufficient for success in physics. Faraday is the classic example of a great physicist who was not good at mathematics, and it is said that Einstein struggled with the mathematics of general relativity. The breakthroughs in physics have often seemed to come out of the blue, and the physicists responsible for them have been described as magicians—Einstein and Feynman come to mind.

The ant was no magician, although its ideas did grow out of a magical experience—the starburst vision described earlier. It decided it had to find a way to tell the physicists what it had learned. Applying its technical skills (it was a retired engineer), it developed a tiny amplifier and speakers that could amplify its little voice so it could reach the ears of a giant way up on the giant’s head. Then, being an ant and able to live wherever it chose, it took up residence in the home of a giant whom it knew to be a famous physicist. It waited for an opportunity, and one day it heard the giant discussing one of nature’s unsolved puzzles on the telephone with a colleague. Afterwards, the ant summoned all of its courage and said, “I can solve that problem for you, and a lot of others besides.”

The giant nearly jumped out of his chair at the sound of a tiny voice coming from somewhere on his desk. The ant spoke again. “I have answers to most of the fundamental questions in particle physics and cosmology.” This time the giant saw the ant. Incredulous, but relieved that the tiny voice was not inside his head, he said, “That’s a pretty cocky attitude.”

“*Antitude*, actually,” replied the ant. “Do you want the answers or not?”

“Show me what you’ve got,” said the giant.

The ant's discourse went on for several hours, during which it told the giant what spacetime is made of, what gravity is and why it is so weak, how inflation really happened and how it ended, why the universe is still in an accelerating expansion phase today, what particles are, how they were created and where their masses come from, what the Higgs field is and why the Higgs boson probably won't be found in collider experiments, why the electroweak scale is so much lower than the Planck scale, why there is electromagnetism, what quarks are, what neutrinos are, why there are no righthanded neutrinos and why neutrinos oscillate between flavors, why there are three generations of quarks and leptons, what dark matter is made of, what time is, and many other wonderful things. The ant then shifted from physics to metaphysics, showing the giant how metaphysics was really physics and that physicists should be the ones studying it, including such things as consciousness, existence, and God. ("Yes," said the ant, "there is a God.")

When the ant had finished, the giant said, "Well, you certainly do have an answer for almost everything. It wouldn't have occurred to me in a million years that the universe works that way. And yet almost everything you've told me supports the standard models. Amazing! On the other hand, some of your answers challenge fundamental physics that I learned as a student and that I and all of my colleagues have always believed to be self-evident. So it seems impossible that your answers can be correct. Besides, you want me to start taking consciousness and metaphysics—even God—seriously. To me these things aren't physics and won't ever be, in spite of what you say. Any halfway decent scientist will tell you there is no God. And it seems to me incoherent to talk about reality as inherently paradoxical and yet worth trying to understand. The bottom line is, I don't like your answers." And he squashed the ant with his thumb. Immediately, he reached for the telephone to tell a friend what had just happened, but before he could lift the receiver, he suffered a massive heart attack and dropped dead on the spot.

The physics community organized a conference to honor the accomplishments of the departed giant. The ant's website soon disappeared from the internet because the bills weren't paid. The ant's published paper gathered dust, unread, in libraries. The physicists kept searching for the answers, but never found them. Ultimately, although they never said so publicly, each one grew comfortable with the idea that the mysteries of the universe could never be fathomed by mankind. There was still full employment for physicists, the conferences still offered ample opportunities for travel, camaraderie, and good eating, the journals still published their papers, and the public still bought their books and attended their lectures, believing that someday these giants would be able to satisfy their hunger for knowledge of the universe. It was a happy time, assuming you weren't an ant.

So what's ultimately possible in physics? It all depends. If physicists hold fast to their beliefs and resolutely refuse to listen to anyone who isn't exactly like them, physics will be stuck for a long time, perhaps forever, but physicists will be prosperous and happy and won't ever have to be inconvenienced by the truth. On the other hand, if physicists can open their minds far beyond what they now think of as open-mindedness, physics will not

only discover the secrets of the universe, but will expand its boundaries to include metaphysics and other topics now considered to be unapproachable by physics.

The fable ends here. But please don't feel sorry for the ant. This is a fable, after all. No ants were harmed in the telling of it, and the ant's wonderful knowledge isn't lost forever. It's all still here, right in front of us.