Theodore Modis

Science with Street Value

A Physicist's Wanderings off the Beaten Track

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To Mihali Yannopoulos

This is a personal account of true events and real people,
but only public figures, well-known personalities,
and Nobel laureates appear with their real names.

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1 – Signs of Disenchantment

Concealing all evidence of a hidden agenda, Ted engaged Pascal, his physics colleague, in the following discussion. Planets far from the Sun, such as Jupiter and Pluto, move around the Sun slowly whereas planets close to the Sun, such as Mercury and Venus move faster. At the same time, distant planets receive less sunlight per square meter than closer planets. Doing the math, Ted had deduced that there was a strict relationship between light received and orbital speed: the more light a planet receives, the higher its speed.

"They behave like living organisms," Ted concluded. "They move according to the amount of heat they receive. Turn on the heat on a frying pan full of ants and see what happens."

Pascal smiled. "If you are trying to prove that planets are living beings, you are not there yet," he mused.

But Ted insisted. "You know the ideal gas law. Gas molecules in a container will agitate as the temperature rises."

"You mean their mean velocity will increase," Pascal objected to anthropomorphizing molecules with the word "agitate."

"Yes, but the frequency of their collisions will also increase resulting to a higher pressure. You know what my wife's shrink suggested to her recently when she told him we've been fighting a lot? 'Get a bigger apartment!' Increasing the volume decreases the temperature and/or the pressure, in other words, the number of collisions. Do you suppose her shrink knows the ideal gas law?" Ted asked ironically.

"I doubt very much that he ever studied the laws of physics," said Pascal and continued," he may, however, know it instinctively. Behind every law of physics there is a fundamental truth. This psychiatrist may have gut knowledge of this truth, which for gases is described by the ideal gas law."

Ted decided not to push Pascal further for now; after all Pascal was the group's leader and this kind of discussion could put Ted's scientific reputation in jeopardy. But Ted wondered how many of the numerous physics laws he had been taught in university might be subconsciously known to non-physicists, and what use of them they may be inadvertently making.

The discussion with Pascal was yet another incident of Ted venturing away from hard-core science. Throughout his life he had become intrigued by topics that science considers taboos, such as miracles, deities, and the supernatural, or by philosophical issues that science simply is not interested in, such as the purpose of life.

"When was the first time I was 'unfaithful' to science?" he wondered. Stretching his memory as far back as he could go he pictured himself as a pre-teen boy with a book at his hands. Its title was *The Great Initiates* by Édouard Schuré.

The book was a study of the secret history of religions and discussed Rama, Krishna, Hermes, Moses, Orpheus, and Pythagoras. The discussion was beyond the little boy's comprehension and he did not read the entire book. But it intrigued him so that somehow this book followed him around the world and his first copy made its way into his library where it still sits today.

But this could not have been the beginning of his "misbehavior." After all, how correct a notion of science can a child have? He remembered another incident when he was a young teenager sitting at dinner table when his older sister, whom he admired for her wisdom and maturity of thought, uttered unexpectedly:

"I'll be for ever indebted to the person who will tell me what the purpose of life is." The question landed like a bomb and froze all conversation. In the absence of a father, Ted's mother felt called upon to take up the challenge. Ted beamed with anticipation.

"The purpose of life is to grow up, get married, and have children, who themselves will later do the same thing," she slowly articulated as she verbalized her thoughts. "What else can it be?" she added almost to herself.

"Well, if that's it, ..." his sister left her phrase unfinished visibly unsatisfied with the answer. Ted retained that the purpose of life couldn't be that simple.

But there was also that white night years later and a few days before Ted left home to begin his physics studies at Columbia University. Together with two other high-school friends he had stayed up all night drinking beer, smoking cigarettes, and pondering on life's existential questions. At some point during the early hours of the morning the topic turned to the existence of God. Ted stopped participating in the discussion claiming that his knowledge of physics was not good enough yet to tackle such questions. In his mind he had clearly linked God with physics.

It wasn't long, however, before his first taste of disenchantment. Two yeas later at Columbia they studied the atom. He found that atomic physics involved too many approximations; left questions unanswered, and employed kitchen-like recipes. This was a far cry from the clean-cut Euclidian approach to classical physics that had fascinated him in high school. There was more such disenchantment for him in the following years. Nevertheless he persevered with his studies as planned; he had been betrothed to science since early childhood and not becoming a physicist was not an option.

When he finally arrived at graduate school and began the research for his Ph.D., he joined a group of physicists preparing to carry out a large-scale experiment at Brookhaven National Laboratory. The group consisted of three post docs, a professor, Jack Steinberger (later Nobel laureate) and another student, Steve. The group was going to study the behavior of the neutral K–meson particle.

One day following a group meeting one of the postdocs challenged the two graduate students: "I'll give a quarter to whoever can write down the state of the neutrino particle that will be coming out from the decay of the K–meson particle we are trying to study." In ordinary language he would be asking: "What do we know about this neutrino particle, how big is it, what charge does it have, how fast is it moving, etc.?"

Ted and Steve scrambled to the blackboard where they worked collectively for about half an hour. An initially simple equation became increasingly complicated as more terms were added to it. At the end they stopped, unable to make further additions or corrections; the postdoc seemed satisfied. "You deserve the quarter," he said. "You can split it between the two of you!" At that moment Jack walked in, saw the equation on the board and remarked, "It is probably not far from the truth."

Ted had found it objectionable that the theoretical description turned out to be so complicated and that the "high priest" found it only probably close to the truth. Ted resented complication even in precisely described phenomena. When they studied the bicycle in a classical mechanics course two years earlier, the equations had proved equally complicated, if exactly accurate in that case. One was left marveling at the contrast of how simple it is to ride a bicycle and how complicated it is to describe the phenomenon scientifically. Complication reduces not only the elegance of a formulation but also its utility. A very complicated theoretical expression is generally of little use.

Elegance is associated with simplicity. Classical physics is excellent in describing billiard ball movements and making accurate predictions. The difficulty comes from putting many balls together and *many* for physicists can be anything greater than three. Molecules in a volume of gas behave very much like billiard balls, but there are too many of them and they bounce too often. However, thermodynamics, the branch of physics that studies gases, makes predictions by focusing only on the macroscopic global variables: temperature, pressure, and volume. The bottom-up approach, tracking individual molecules, taxed the ingenuity of the best minds in physics for at least one-hundred-and-fifty years and has served only in understanding, corroborating, and justifying the relations established experimentally between the overall variables.

By and large, complicated formulations in physics have remained academic exercises.