Commentary

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A Philosophical Approach to Aspects of Memory and Consciousness

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ABSTRACT

Science in the modern age advances by the scientific method, which involves the experimental testing of hypotheses, continually revising them to better fit experimental observations. Nearly all articles in scientific journals report results of experiments that test hypotheses, that were in turn tested by earlier experiments. That means that the experiments that come next are based on those that have gone before. A flaw is that it does not provide a route to provide hypotheses that are completely new, and not inspired by previous hypotheses and experimental results.

Centuries and millennia ago the primary means of discovery was Philosophy, which was based on the premise that the path to knowledge is to start from fundamental axioms and through a logical process of pure reason, arrive at explanations of everything. I thought it possible that by invoking a philosophical approach one might discover sui generis concepts that would be a source of novel hypotheses that were not inspired by previous hypotheses. Inspired by Rene' Descartes' 'I think therefore I am,' I chose instead 'That which cannot be observed does not exist.' Following a logical path from there was easy, and I was surprised how many novel concepts emerged. Unlike most philosophical ideas, some of these concepts were subject to experimental tests. One was that a thought exerts a physical force, and a collection of our thoughts could provide a measurable force. This led to the design of a pendulum that was able to detect and analyze the substantial forces that surround a subject. These experiments would not have been done without the idea that thoughts exert a physical force. Another novel concept is that translocation of objects is a complex process that resembles a chemical reaction. This was used to derive an equation that embodies the laws of motion and defines terms for inertia and momentum. The concept was expanded by an argument that it could be possible for objects to accelerate and slow down without having to overcome inertia and momentum.

Other concepts were related to memory and consciousness and suggested completely new ways by which the brain forms and recalls memories. There are many studies of the brain, and these are designed to test current hypotheses. Instead of performing new experiments, one could take those experimental results and see which hypothesis better explains them. Examples are provided that the show the philosophical hypothesis is the better one.

Many concepts were discovered that are not described here. It is likely that many are incorrect, but perhaps some are not. Those that are correct could provide previously unavailable hypotheses that could drive discovery new directions. If this approach bears fruit, it may be useful to merge classical philosophical approaches with modern scientific methods. It may be a way to recover some of what was lost when the Library of Alexandria was burned.

COMMENTARY

My academic research areas are biochemistry and molecular biology [1-8], which employ experimentation and the scientific method. I have been fascinated by the discipline of Philosophy because it proposes to gain knowledge of the universe through pure reason, which does not employ experimentation. Rene' Descartes used 'I think therefore I am' as his starting point and developed very important philosophical arguments that are relevant today, although he was disappointed that his philosophy was not as encompassing as he had hoped. I wondered if he had started with a different axiom, that he could have been more successful. I chose instead 'That which cannot be observed does not exist.' I assumed the development of a philosophy from there would fail early on, but it did not; and it continued on to touch nearly everything. Although surely flawed, I published it as a book, Treefall [9], named in homage to the tree that falls in the forest.

Among the topics explored were aspects of memory and consciousness. For example, it was proposed that as we initiate thoughts, the thoughts exert actual physical forces. Unlike most philosophical conjectures, this one appears amenable to experiments to measure those forces. The force exerted by a single thought could be small, but our brains are teeming with thoughts, so the collection of them could provide a measurable force. This led to the design of a torsion pendulum suspended above a subject to detect, measure, and analyze physical forces. Experiments performed over several years supported this hypothesis, resulting in several publications [10-13].

When Treefall encountered memory that is associated with consciousness, a radical idea emerged, which was our memories are not stored in our heads, but somewhere else, perhaps another dimension. Mainstream theoretical physics are proponents of 'multiple and parallel universes'. These ideas have emerged from String Theory and the bizarre nature of Quantum Mechanics [14-17].

What concerned me was that human memories can be so vast that it seemed impossible to contain them within the brain. Whereas most people forget things, some forget very little. Those who have 'photographic memories' are fairly common. Rare individuals can have astonishing recall of memories. One is Jill Price, 'The woman who can't forget' [18]. Starting from age 14, she has total recall of every day of her life and can relive any one of them at will in complete detail in every way, with high-definition vision, sound, smells, emotions, etc. She has been diagnosed with hyperthymesia, which is a superior autobiographical memory; a condition she shares with 60 other known individuals. Another is Kim Peek [19], who was a Savant in a dozen separate categories, including an astonishing memory. After a single read of a book, he could recite perfectly from any page in it, even after years. A voracious reader, he had thousands of books in his memory. For fun he would memorize airline schedules and could tell at any moment what flights were taking off and landing in say, Frankfurt or Chicago.

Now consider what is known about how and where memories are stored in the brain. There is a vast literature in this e.g. [20], but it boils down to memories not being stored in specific locations in the brain like in a computer, but somehow 'spread all over.' The medium of storage is thought to be brain synapses, and as we learn something, the synapses undergo modifications that incorporate memories for later recall. There is no claim to understanding how synapses could record and retain the high-definition visual and other sensory input, nor a mechanism for recalling those memories.

Considering how memories are stored in computers, the amount of computer memory that would be required to store the life-time memories of Jill Price or Kim Peek would be vast. All that high-resolution data that has come in over decades of Price's life has to be stored somewhere. These data would not be gigabytes, nor terabytes, but many petabytes. These would likely fill much if not all of YouTube's servers. I assert that it is impossible for that much data to be stored in her body.

The Treefall argument is that the brain does not consist of memory storage, but is instead a complex collection of resonators, with each lobe of the brain having dedicated resonator functions. For example, as the visual lobe receives input it would resonate with that input and lay down a data path into a location outside the brain. For simplicity, suppose the location is the dimension of the past, and as we have visual experiences, they remain stored exactly where they originated, in that past dimension, at the time they occurred. To recall that memory, the visual lobe resonates with the actual past event, so we see it as if we are actually there.

Supporting this idea are the amazing and bizarre observations made of 'Mr. M' [21], a patient with severe epilepsy. At the time, epilepsy treatments included excision of portions of the brain that were thought to be responsible for seizures. Considering the severity of the case, it was decided to excise his entire hippocampus, which had never before been tried. The good result was that it did relieve his seizures, but a side effect was that he could no longer form new memories. His memories from before the surgery were vague and was a span of only 30 seconds after the surgery. It is said that he is the most studied brain subject in medical history. He could carry on a simple conversation about subjects from his past, but a few minutes later he had no memory at all of the conversation. He lived in an eternal present and was incapable of understanding his circumstances. These could be explained to him, and he would be able to express understanding, but within a few minutes that understanding was completely forgotten. This is consistent with the idea that the hippocampus that was excised is a resonator that has a central role in converting current experiences into past-dimension memories from where they can be retrieved through resonance.

A central element of being human is our ability to remember experiences and use them to plan and execute future actions. For our primitive ancestors, it would have been important to be able to remember an encounter with a poisonous snake, so as to avoid them in the future. Without our memories we would have no sense of self. Biological evolution would put a premium on the ability to form and recall memories, but it might be best to focus on important memories, and not all of

them, as for Jill Price and Kim Peek. Price has said that it is an ability that can be difficult to live with. She is subject to suddenly recalling in complete detail a day with traumatic or unhappy events. Although most of us recall unhappy experiences, the memories are usually dulled by the passage of time. 'Time heals all wounds,' as they say. Not for Price and Peek.

With respect to evolutionary processes being able to exploit another dimension for memory storage, it is argued that biological selection can draw upon any of the fundamental principles of the universe, and not be limited to those that scientists know and understand. If it is not forbidden by Nature's Laws to store memories in an alternate dimension (the theoretical physicists claim there are alternate dimensions), then natural selection can exploit it without our knowing anything about it.

The possibility that our memories are stored in an alternate dimension could have a profound effect on us. We live within our physical present, but we need our memories. Much of our knowledge of who we are is a consequence of our being able to form memories and use them to move forward in our lives. If our memories are in another dimension, we are living both within that dimension while interfaced with the physical dimension we are actually in. We therefore live between two separate worlds, the world of the present and the world of the past. Without our memories of the past, the world of the present would be meaningless, as it was for Mr. M.

The only way that this radical idea could be accepted would be to adopt it as a hypothesis, and subject it to experiment, to see if the results are consistent with the hypothesis. Those experiments have already been done by the thousands guided by current hypotheses about the brain and memory. All that would be required would be to review those experimental results and see which hypothesis is better at explaining them.

An example is the extraordinary ability of people to rapidly recognize faces. If you were walking down the street and encountered an old high school friend like Keith, you would immediately recognize him despite not having seen him for a decade. Computers are used for face recognition, and the way they do this is to have a huge database of face pictures and compare them one by one with the face picture at hand, looking for similarities. Our brains may have an alternative option.

An analogy is a room filled with tuning forks, each tuned to the frequency of a particular note, and only one of them is tuned to middle C. Tasked to find the middle C tuning fork, one would need to tap each fork one at a time and use an instrument to determine the frequency. If there were a million tuning forks, this would take a long time. Suppose instead there is a bell in the room that rings with the frequency of middle C. If you struck the bell, the middle C frequency would permeate the room, and only the middle C tuning fork would vibrate because of resonance with the bell frequency. The discovery of the middle C tuning fork would be instantaneous. This analogy provides an explanation of instant facial recognition. When you see Keith, what you see resonates throughout your memories and the only memories that resonate perfectly with what you are seeing are those of Keith. The hypothesis that facial recognition uses a process involving resonance is a better explanation than the one utilizing a computer-type recognition process.

Another example is Alzheimer's Disease, in which development of amyloid plaques throughout the brain and especially the hippocampus is accompanied by impairment of the ability to form and recall memories, but the mechanism of impairment is not known. An analogy is a silver bell, which when struck resonates with a clear tone. Suppose by some means, the bell was slowly invaded by grains of sand. As they accumulated the resonant tone of the bell would be degraded, to the point it would just go 'thunk.' Accumulation of the amyloid proteins would have the same effect on the ability of components of the brain to properly resonate as do the grains of sand, so the ability to form and recall memories would degrade and ultimately be lost completely. The observations related to Alzheimer's are easily rationalized in terms of the resonance hypothesis.

Another notion developed in Treefall is that the simple translocation of a physical object from one position to another is actually an extremely complex process that resembles aspects of chemical reactions. An equation of motion was derived using this idea. The resulting equation embodied the laws of motion and includes terms that define inertia and momentum. This concept was expanded and published separately [22]. Although not proof that translocation is like a chemical reaction, it is consistent with it. Translocation as a chemical reaction leads to other conjectures. Biology is possible because intracellular reactions are catalyzed by enzymes, which are catalysts. We have thousands of enzymes, each of which is evolved to catalyze a specific reaction. The extent to which enzymes can accelerate reactions is extraordinary, a billion-fold or more [23]. For any chemical reaction to occur, the reaction has to pass through a high-energy transition state during which molecular orbitals of the reactants undergo reorganization to form those of products. The activation energy to attain and cross the transition state energy barrier is usually by molecular collisions. Enzymes achieve rate accelerations by reducing the height of the transition state energy barrier, so the reactions proceed with much lower input of activation energy.

That translocation may possess attributes of a chemical reaction suggests that it could be catalyzed, in the way that enzymes catalyze chemical reactions. Lowering the transition state energy barrier of the translocation reaction would reduce the amount of activation energy (inertia) required to initiate translocation and reduce the amount of momentum that would need to be drained away to slow down. If the lesson of enzymes is relevant, it is that if the height of the transition state for translocation can be lowered, an object could be set in motion with very little input energy and stop easily. Vehicles could attain high speeds almost instantaneously, make sharp turns, and come to rest almost instantaneously.

If such a catalytic effect is possible, it is not obvious how to achieve it. Treefall proposes that it has already been achieved by biological systems and makes life as we know it possible. Biological evolution can exploit any facet of Nature that is not forbidden, and if catalysis of translocation is not forbidden, then it is likely that evolutionary processes discovered it a long time ago and have been using it ever since. It is suggested that we move our body parts by using the force of thoughts to somehow catalyze translocation, perhaps by altering conformations of proteins. A candidate for a cellular component that has evolved to catalyze translocation is the neuron.

It is not a robust hypothesis, but we have to start somewhere. This is reminiscent of how biochemists were able to discover how cells synthesize adenosine triphosphate (ATP) despite its being a very energetically unfavorable reaction. Peter Mitchell noticed that the hydrolysis of ATP released a proton (hydrogen ion) into solution, and if you were to sufficiently increase the hydrogen ion concentration you could drive the reaction in reverse [24]. Calculations showed that would require an extremely high concentration of hydrogen ions (a very acidic low pH), which is incompatible with intracellular pH's being not far from 7. Mitchell experimented and revised his hypothesis through several stages. In the meantime, Paul Boyer was using sophisticated biochemical approaches to characterize whatever enzyme was catalyzing ATP synthesis [25]. He devised an elaborate model of the enzyme structure and the mechanism of how it would work. It was then that J. E. Walker obtained a high-resolution X-ray structure of ATP synthase that confirmed the Boyer model [26]. ATP synthase is an amazing molecular machine with many moving parts that can convert the energy of hydrogen ions into ATP. The lesson is that Mitchell started with the hypothesis that ATP synthesis would become favorable at very low pH. Although it was a dubious hypothesis, it pulled a thread whereupon the entire mystery of ATP synthase completely unraveled. It is better to start with a dubious hypothesis than nothing at all.

The philosophical journey of Treefall touches many concepts that are beyond the scope of this Commentary.

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