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# Physical Foundations of Biological Mentality

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## Abstract

Dualism struggles to connect two layers: the conscious mind and the physical workings of matter. It ignores a vast middle layer between the two, a layer that is beneath consciousness yet above known physical law. This middle layer is trans-robotic mentality, a means discovered by Nature to transcend robotic mentality. This middle layer evolved over billions of years before consciousness emerged from it, assuming more and more functions critical to survival as species evolved. Consciousness eventually emerged from trans-robotic mentality (not from robotic mentality), first intermittently then later more-or-less continuously. But there is no direct link between consciousness and matter. Every moment of human consciousness is utterly dependent on processes that transcend the known physical processes of matter. Trans-robotic processes are in some sense physical because they are “powered by” converted mass-energy that disappears from the physical world (and can reappear in acts of free will). But in another sense they are not physical because they have genuine autonomy and externality from the known laws of physics. What we call mind is the simultaneous combined (and oft-times conflicted) operation of all three layers: robotic, trans-robotic, and conscious. Based on these conjectures, a new mind-matter theory is presented which predicts experimental violations in the principle of conservation of mass-energy in living organisms.

**Keywords:** *Biological mentality, Mind-matter, Consciousness, Non-consciousness, Robotic mentality, Evolution of mentality*

## 1. Introduction

Every living organism has some capability to sense and modify its environment by making physical changes (e.g., mechanical, electrical, chemical) to parts of its own body that in turn connect with that environment. I call the process between sensing and effecting change *biological mentality*, a term meant to include but not require consciousness and also meant to include but not be limited to known physical processes. The biological mentality of the earliest life forms on Earth may have been entirely robotic, i.e., deterministic<sup>1</sup> and Turing computable. However, at some point in time evolution produced another kind of mentality, *trans-robotic mentality*, that, while still less than consciousness, provided a survival advantage over purely robotic processes. Consciousness emerged *much later* in the evolution of life, following billions of years of trans-robotic mentality development.

## 2. Physics and free will

*Free Will* refers to those thoughts and actions not predetermined by physical law, not arbitrary or random, not the result of any kind of compulsion. Free will is the power of choosing without the constraint of necessity or fate.

Although we sense the difference between a free choice and a compelled choice<sup>2</sup>, our sense is not 100% reliable. For example, we may honestly believe we have freely chosen to perform actions that were really compelled by post-hypnotic suggestion.

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1 Throughout this paper, “deterministic” is meant to include the probabilistic theory of quantum mechanics, which is deterministic plus random.

2 Penfield applied a mild electrical stimulus directly to the motor area of an exposed brain, unseen by the patient, causing a movement. The patient knew that he did not will that movement. (Penfield, 1975).

If, in spite of this, we still believe in free will, then the following must be true: Something external to the known physics of the brain must do work on physical objects within the brain (such as moving molecules in synapses). Belief in free will implies an injection of energy from a source external to the world described by today's physics. From this root statement the remainder of this paper derives.

Quantum physics introduces randomness into physical laws, but randomness doesn't really provide a means of free will. There is just no room for free will in a physical system made up of deterministic laws and randomness. Robots, including quantum robots, can only simulate having free will. In reality, they simply must do what they are programmed do.

In order to really have free will, your physical brain must be augmented by something that can physically interfere with its workings. To do work within your physical brain it must be able to inject energy to do the work.

### **2.1. Where did this external energy come from?**

If mentality space can inject energy into the brain in executing free will, then perhaps mentality space was derived from energy originally extracted from the physical world. As will be discussed, perhaps there are as-yet-undiscovered processes in the brain that drain energy (literally making energy disappear from the physical brain) converting the lost energy into mentality space.

## **3. Trans-robotic mentality**

*Trans-robotic mentality* is my term for mentality that transcends limitations of deterministic mentality (which I call *robotic mentality*) and does so by means of energy exchanges between the physical living organism and something external to the physical living organism that I call its mentality space.

A man-made robot has no mentality space. Although computer algorithms can simulate behavior, including emotional behavior and apparent free-will choices, the robot does not have any externality from its deterministic processes: it *has* to do what it is programmed to do.

Perhaps the earliest organisms, bacteria and archaea, have only robotic mentality because metabolic energy limitations prevented them from “discovering” trans-robotic mentality, that is, they did not have excess internal power needed to hit upon this discovery. If so, there is nothing phenomenal in the life of a bacterium.

Eukaryotes, with their reproducible-as-needed internal mitochondria, have no such internal energy limitations: see (Lane, 2005). And, in addition to mitochondria, many other new internal structures appear in eukaryotes including the cell nucleus and microtubules, the latter having remarkable physical properties (Craddock TJA, Friesen D, Mane J, Hameroff S, Tuszynski JA. (2014)). With the power of mitochondria and the shape-shifting enablement of microtubules, eukaryotes pioneered a whole new dimensions of life including active hunting. With these new powers came more difficult problems of control, and trans-robotic mentality evolved as a solution to at least some of these problems.

### **3.1. Over-adaptation**

Adaptation in man-made systems involves machine learning, a fully deterministic process. One approach to machine learning relies on fitting mathematical functions to observed data points, i.e., records of process inputs, outputs, and consequences, and then using the fitted functions to compute the effector responses to incoming sensor signals most likely to result in the desired consequences. In this approach, there is a trade-off between the degree of fit to the previously-sensed data points and the overall smoothness of the fitted mathematical function. A function that hits every given point dead on but wildly fluctuates between the points

is less desirable for control than one that comes close to the given points but is much less wild. Overfitting in machine learning for many kinds of applications can be a serious problem (Augustyn, K. (1992)). Likewise over-adaptation can be one of many serious problems in adaptive control.

What might trigger an injection of energy quanta from mentality space to do work on the cell in order to stop or reverse over-adaptation? As an analogy, cell phones and laptops provide the user with easy ways of hitting restart as a quick way of solving many performance problems. Options such as *return to factory settings* solve more serious problems by undoing what can be thought of as over-adaptation of the device to the user's specialized needs and wants. Words like *flailing or thrashing* connote a sense of loss-of-control while also implying a degree of high energy expenditure. Perhaps when an early eukaryote found itself flailing some of that "wasted" energy was exchanged into mentality space and then re-exchanged into energy for work necessary to effect the reset.

### 3.2. Process Control

Any natural process, such as a single lump of coal burning on the ground in the open, may continue on in a steady state for a period of time without any external control. But if a process is to survive in a steady state over a long period of time, such as the continuous burning of coal in a furnace heating a building's steam boiler, some kind of process control is needed. In control engineering, the process (such as the coal-fired furnace) is typically called *the plant*. Man-made process control systems are external to the plant. Typically process control systems consist of sensors, control algorithms running on computers, and effectors which operate on the regulators of inputs to the plant or on other parts of the plant to which they are connected. By control we mean that the process control system is supposed to keep the process running smoothly, without blowing up or wildly fluctuating. In the case of a coal-fired furnace, the goal of

maintaining a steady set temperature is achieved by adjusting air flow dampers, activating augers to add coal, activating grates to shake out ash, etc. To achieve control, sensors, processors, effectors consume energy and do work on the plant. Points to note here are:

1. The process control system is a separate part of the physical world, external to the plant being controlled
2. It requires energy to function
3. One payoff is extending the life of the process being controlled
4. Other payoffs include maintaining quality of the process output and adapting to changing environmental conditions
5. The control algorithm needs to be created, verified mathematically, and tested. For fast and complex processes, it is not simply a given that an adequate control algorithm can be found.

There are classes of very difficult control problems (Anderson, B. and Dehghani, A. (2008)). Control is not something that just comes naturally, and failure to control can be catastrophic. This from a highly respected Seattle Times aerospace reporter on the crash of Lion Air flight JT610:

*As soon as the Boeing 737 MAX was airborne, the captain's control column began to shake as a stall warning. And from the moment they retracted the wing flaps at about 3,000 feet, the two pilots struggled — in a 10-minute tug of war — against a new anti-stall flight-control system that relentlessly pushed the jet's nose down 26 times before they lost control. Though the pilots responded to each nose-down movement by pulling the nose up again, mysteriously they didn't do what the pilots on the previous day's flight had done: simply switched off that flight-control system.<sup>3</sup>*

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<sup>3</sup> <https://www.seattletimes.com/business/boeing-aerospace/black-box-data-reveals-lion-air-pilots-struggle-against-boeings-737-max-flight-control-system/>

Because even the most primitive single-cell organism is a composite structure containing a spatial distribution of highly complex chemical feedback processes and because such organisms *do* survive over extended periods of time, perhaps the emergence of higher mentality had survival value because it solved a process control problem and did so by externally turning off or resetting its robotic mentality mechanisms. We conjecture that energy is required to produce this externality and that payoffs such as extending lifespan and adapting to changing environmental conditions were realized consequences.

The biological mentality of a single-cell eukaryote organism consists of both robotic mentality and trans-robotic mentality. The point to note here is that trans-robotic mentality emerged very early in the evolution of the species, perhaps with the emergence of single-cell eukaryote organisms, as Nature's solution to problems stemming from limitations of robotic mentality. Then over billions of years trans-robotic mentality co-evolved with the species, assuming many more functions via exaptation, culminating in what we call our human subconscious and, eventually, (as will be discussed) consciousness.

*Trans-robotic mentality is not consciousness.* Consciousness comes much later in the evolution of living organisms. For now is important to put consciousness aside and focus on the idea that the biological mentality of organisms that are presumably not yet conscious have certain trans-robotic capabilities that exceed organisms limited to robotic mentality. These capabilities include precursors to our human subconscious. They require a means to do work on the organism yet are external to the physical processes of the organism.

Trans-robotic mentality is an entirely new concept in mind-matter theory. Roughly, it corresponds to a layer between robotic mentality and consciousness, a layer that came into being after life evolved from non-life and that developed for billions of years before anything like consciousness emerged.



#### **4. The undiscovered physics of trans-robotic mentality**

Trans-robotic mentality involves energy flows in opposite directions between the organism's physical structure and the organism's mentality space. Mentality space is "powered" by energy removed from the physical world by the organism, and in occasions of free will, energy can flow back to the physical organism doing work on it and thereby changing its otherwise-deterministic trajectory.

As yet undiscovered, the physics of mentality space creation and maintenance may have some analogy to parametric down conversion, where a photon injected into a certain kind of crystal may split into a pair of lower-energy entangled photons. This physical process can be implemented on semiconductor chips using an aluminum-nitride microring resonator (Guo, X. (2017)). Perhaps in the living eukaryote cell something similar happens. A photon injected from mitochondria into an adjacent microtubule bundle splits into two lower-energy entangled quanta, one part transforming into mentality space and the other part absorbed by the cell. This would result in energy moving from the physical cell to its mentality space while remaining connected to the physical cell via entanglement. The mentality space built up from such events is not "in" the physical world but is still entangled with it, such entanglement allowing energy to be removed from mentality space and injected back into the physical world in acts of free will. Free will requires at least a tiny degree of autonomy or externality from the organism's robotic capabilities and this must have causal powers, i.e., it must be able to do work on at least some of the biochemical processes within the organism, causing such processes to deviate from their otherwise-deterministic trajectory. To do such work, this externality must be able to inject energy quanta into the organism, and this external energy comes from mentality space.

Mentality space in some ways resembles a physical field, such as the

electromagnetic field, in that it can be injected with energy quanta and can inject energy quanta back into a suitable physical structures. However, mentality space is unlike the electromagnetic field in that it is not associated with points in space (hence I avoided the term *field*). Mentality space will require new physics, but new in the sense of something extra that emerged with living organisms rather than new in the sense of correcting something wrong.

The as-yet-undiscovered physics of trans-robotic mentality will no doubt involve quantum processes, as the analogy to parametric down conversion suggests. But as should be clear, I have not adopted Penrose's theory of objective reduction (Penrose, 1989) or Stapp's theory of collapse-causes-consciousness (Stapp, 2009).

## **5. Testing the principle of conservation of mass-energy on living organisms**

A living organism is an open system continuously exchanging mass and energy with its environment. We can imagine measuring all of these exchanges over a period of time, including changes in the mass of the organism. Let  $E_{in}$  represent the total mass-energy input to the organism, e.g., energy released by metabolism, absorbed electromagnetic energy, etc. Let  $E_{out}$  represent the sum of all physical mass-energy transformations, e.g., the heat produced by the organism as well as any changes in its mass. The ratio  $R = E_{in} / E_{out}$  is expected to be unity according to the principle of conservation of mass-energy.

There are great difficulties in designing such an experiment, and at this time it is not clear to what degree of accuracy  $E_{in}$  and  $E_{out}$  could be measured using today's best technology.

### 5.1. What experimental results would we expect?

In living organisms the trans-robotic mentality conjecture predicts that  $E_{in}$  will be more than  $E_{out}$  and therefore  $R$  will be greater than 1. This is because a portion of the energy produced by metabolism is continuously being drained from the physical world (literally disappears from the physical world) to maintain the mentality space of the organism. The instantaneous rate of this drainage is expected to fluctuate as the intensity of mentality fluctuates; e.g., higher rate when awake than when asleep, higher when confronted with a problem than when at peace. In organisms with rudimentary mental capabilities we would expect the drain to be intermittent rather than continuous.

In the other direction, energy for free-will acts will be drawn from mentality space and injected back into the organism. This too will also fluctuate in intensity as more or less free will is executed. These fluctuations in flows that are in opposite directions will sum, resulting in overall fluctuations in  $R$ . These fluctuations are predicted to be in apparent violation of the principle of conservation of mass-energy.

Would it be possible to instantaneously measure  $E_{in}(t)$  and  $E_{out}(t)$ , we would expect both to fluctuate. We would also expect the integrated  $E_{in}$  to be more than the integrated  $E_{out}$  because the maintenance of mentality space drains more energy than injected by free will events. Unfortunately at this time we have only this qualitative expectation; we do not have a quantitative expectation for the integrated  $R$ . This is why it will be important for experts to determine to what degree of experimental accuracy  $R$  can be measured in living organisms. Let us assume for purposes of discussion that  $R$  has an experimental accuracy of  $\Delta$ . Experimentally measuring  $R$  outside the range of  $1 \pm \Delta$  would provide evidence of a violation of the principle of conservation of energy if the living organism is taken to be nothing but a physical system. On the other hand, such an experimental result would provide indirect evidence that the living organism is a physical

system that is *augmented* by something that is non-physical in today's physics (but not necessarily non-physical in tomorrow's physics).

## 6. A possible evolutionary history

According to our best physical theories, the Earth formed some 4.3 billion years ago (bya), approximately 9.5 billion years after the big bang. Fossil evidence for bacteria on Earth dated 3.7 bya shows that living organisms did not take long to appear. We have plausible theories on how life could have emerged from non-life here on Earth (Lane, N. (2015)), as well as theories of how life could have arrived from elsewhere in the universe (Steele, Al-Mufti, Augustyn, Chandrajith, Coghlan, Coulson et al. (2018)). First life from either source provided the seed for evolution of higher forms of life.

### 6.1. Eukaryotes

Until the advent of eukaryotes 2.2 bya, earlier organisms had severe metabolic energy limitations (Lane, 2005). Eukaryotes, with their internally reproducible mitochondria, can produce all the ATP needed and more provided there is sufficient food to metabolize. And perhaps all of this power created new problems in control, somewhat like an inexperienced driver getting behind the wheel of an extremely powerful sports car. Also eukaryotes have microtubules, structures with remarkable physical properties that may have something to do with the undiscovered physics of trans-robotic mentality.

### 6.2. The True Individual

As eukaryotes evolved so did their biological mentality capabilities, both robotic and trans-robotic. But eukaryotes have only single-cell mentalities. The true individual is a multicellular organism composed of specialized

cells: reproductive (germ) cells and nonreproductive (somatic) sterile cells. It is not until the advent of the true individual 0.7 bya that a much more elaborate multi-cellular mentality seems possible. The specialized cells collaborate for the greater good of the whole. Specialized *proto-brain cells*, free of other tasks, found ways to *collaboratively* utilize their individual trans-robotic capabilities. Groups of specialized proto-brain cells found ways of merging their mentality spaces, *enabling mentality generated from some cells to physically influence other cells*. Such a merged mentality space could support much richer adaptive capabilities than single-cell mentality, but would still be phenomenally intermittent.

### **6.3. Warm-blooded Organisms**

Continuous mentality required the continuous endothermic temperature regulation characteristic of many mammals and birds which appeared a mere 0.2 bya. So-called cold-blooded organisms use exothermic means (e.g., basking in the sun) to warm body temperature. Warm-blooded organisms regulate endothermically. Endothermy is continuous and not dependent on muscle activity. It is achieved by having about five times as many mitochondria in the visceral organs as equivalent cold-blooded animals. Note that once again an energy problem had been overcome in Nature, perhaps for several adaptive reasons (as endothermy gives greater stamina, speed, endurance, aerobic capabilities) but perhaps also for enabling a more stable and continuous mentality.

### **6.4. Many other Mentality Milestones**

Since the emergence of primates, there have been many other important state-change improvements that are relevant to the increasing power of biological mentality. For example:

Primate micropackaging of neurons (Herculano-Houzel, S. (2017)): In the evolution of non-primates, every time the number of neurons increased

the average size of neurons also increased. Whereas In primate evolution, the newer larger-brain species do not have larger neurons. Primates have more neurons compared to non-primates with approximately the same brain mass.

There have also been anatomical additions to the brain in primates such as the prefrontal cortex that has no counterpart in the mouse (Rakic, P. (2009)).

## 7. The emergence of consciousness

The mentality space of the very first single-cell organism having “discovered” trans-robotic mentality is something like disconnected moments of extremely primitive and overwhelming survival emotions such as overwhelming panic. It is nothing like our conscious awareness. It is at most only brief, disconnected phenomenal events transcending internal robotic processes.

Panic just might save the day when all else fails. Of course one can think of an algorithm for simulating panic because one can think of an algorithm that simulates *any* function of mentality. But that doesn't mean that the algorithmic simulation *is* the reality. Unfortunately, a common misunderstanding of the Turing test has created a huge problem. A bogus idea is now common that if you can't tell the difference between A and B, then A *is* B, that is, if a robot can simulate an emotion, then the robot has the emotion. Applied to fake food (Olmstead, 2016), one would then have nothing to complain about in the following:

*In New York, students did DNA testing of purchased sushi and retail samples and found that among other things, 78% of red snapper was a far cry from red snapper. In December, non-profit ocean conservation group Oceana had released a report titled “Widespread Seafood Fraud Found in New York City.” Their more extensive*

*study found that 39% of Big Apple restaurants and retail fish sellers committed fraud, as did every single one (100%) of the 16 sushi restaurants tested. Boston and LA fared even worse, with fake fish rates of 48% and 55% respectively.*<sup>4</sup>

Emergence in physics is defined in many ways, all of which are highly controversial (Kivelson, S. (2016)). Emergence can mean first realization in the history of the universe. Laws of nuclear forces, for example, emerged (in this sense) with the first appearance of elements having nuclei more complex than hydrogen. Before that moment in time, there were no nuclear forces simply because there were no complex atomic nuclei to have them. Historical circumstances, in this case the gravitational fusing of hydrogen to make the first helium, enabled this emergence (this example from Popper, K. (1982)).

A much richer concept of emergence was introduced in a key paper (Laughlin and Pines (2002)), and further developed in a follow-on book (Laughlin, 2005). Laughlin focuses on emergence as a function of the organization of constituent parts that themselves do not exhibit the emerged property, e.g.,

*... the ability of certain metals to expel magnetic fields exactly when they are refrigerated to ultralow temperatures strikes us as interesting because the individual atoms out of which the metal is made cannot do this.*<sup>5</sup>

*... the organization can acquire meaning and life of its own and begin to transcend the parts from which it is made. What physical science thus has to tell us is that the whole being more than the sum*

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4 <https://www.forbes.com/sites/larryolmsted/2013/02/21/fake-fish-on-shelves-and-restaurant-tables-across-usa-new-study-says/#2305c4f24f23>

5 <https://www.nytimes.com/2005/06/19/books/review/a-different-universe-you-are-more-important-than-a-quark.html>

*of its parts is not merely a concept but a physical phenomenon. Nature is regulated not only by a microscopic rule base but by powerful and general principles of organization. Some of these principles are known, but the vast majority are not. New ones are being discovered all the time. (Laughlin and Pines (2002))*

The single-cell organism, has only the occasional disconnected and extremely primitive phenomenal experiences of trans-robotic mentality. With the advent the higher true individual multicellular organism with specialized proto-brain cells, some of the multiple mentality spaces from these individual cells merged together in an emergence in the sense given by Laughlin. This merged multicellular mentality is that which supports consciousness. Without it there is only robotic and trans-robotic mentality.

Prior to the appearance of endothermic life (warm-blooded birds and mammals), the consciousness enabled by the merged mentality spaces was at best intermittent. With the advent of endothermic organisms, more-or-less continuous consciousness became energetically possible.

As we have discussed, consciousness came after billions of years of non-conscious, non-computable, non-deterministic trans-robotic mentality which itself transcends Turing-computable, deterministic robotic mentality. In all cases, consciousness is utterly dependent on a base of *both* robotic and trans-robotic mentality. We call this base by many names: the subconscious, the unconscious, or the non-conscious mind.

*Without consciousness we would not have the experientially flavoured world we have, but without the non-conscious we would not have it at all; for we would not be able to breathe, eat, move, walk, feel, mimic, gesture, laugh, etc., and even see, talk, remember, understand, think, imagine, and make myriad spontaneous decisions as we continuously do in all life situations, from trivial to existential*



*ones* (Radman, Z. (Editor) (2017)).

A feature of human consciousness is our fallible sense of having at least some limited degree of free will. Free will discussions are complicated by the fact that conscious and subconscious processes are tightly intertwined. The subconscious can, for example, deliver to consciousness a rationalized certainty that some bizarre action was freely chosen when in fact it was the compelled consequence of a post-hypnotic suggestion. And consciousness can delegate tasks to the subconscious similar to initiating a random number generator. Once so delegated, the brain can “move the finger at random” on its own, with conscious awareness of the movement coming *after* the brain processes responsible for the movement.

## **8. Relationship to contemporary mind-matter theories**

I am not an expert in the many contemporary frameworks of mind-matter theory such as described in the entries classified under “philosophy of mind” in the Stanford Encyclopedia of Philosophy.<sup>6</sup> But in my opinion, the mind-matter theory presented in this paper is new and does not fit into *any* of these contemporary frameworks.

It is not dualism. Dualism struggles to connect two layers: the conscious mind and the physical workings of matter. It ignores a vast middle layer between the two, a layer that is beneath consciousness yet above known physical law. This middle layer is trans-robotic mentality, a means discovered by Nature to transcend robotic mentality. This middle layer evolved over billions of years before consciousness emerged from it, assuming more and more functions critical to survival as species evolved. Consciousness eventually emerged from trans-robotic mentality (*not* from robotic mentality), first intermittently then later more-or-less continuously.

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<sup>6</sup> <http://consc.net/guide/>

But there is no direct link between consciousness and matter. Every moment of human consciousness is utterly dependent on processes that transcend the known physical processes of matter. Trans-robotic processes are in some sense physical because they are “powered by” converted mass-energy that disappears from the physical world (and can reappear in acts of free will). But in another sense they are not physical because they have genuine autonomy and externality from the known laws of physics. What we call mind is the simultaneous combined (and oft-times conflicted) operation of all three layers: robotic, trans-robotic, and conscious. Based on these conjectures, a new mind-matter theory was presented which predicts experimental violations in the principle of conservation of mass-energy in living organisms.

## **9. Summary and Conclusions**

Mind and matter both really exist. Matter came first and life emerged from matter. At some point in evolution, an entirely new and to-be-discovered process of removing energy from the living organism and injecting energy back into that organism in order to alter otherwise-deterministic biochemical processes was discovered by Nature as a means of transcending limitations. Organisms at this stage of evolution had two layers of mentality, robotic and trans-robotic, but still lacked consciousness. For billions of years, these two layers evolved and became more powerful in solving survival problems as organisms conquered new environmental niches. Consciousness eventually emerged from the merged mentality space of true individual organisms, first intermittently and later, when endothermic organisms emerged, more-or-less continuously.

Well before consciousness emerged, a kind of free will came into being with trans-robotic mentality which provided early living organisms with some genuine autonomy or externality from their deterministic biochemical

processes. Trans-robotic mentality intervenes in the otherwise-deterministic processes of a physical system, e.g., it can inject energy into structures within the organism, doing work on these structures and thereby changing their otherwise-deterministic trajectory. What such an organism does, therefore, in generating and interacting with mentality space is not only not computable, it is not even fully deterministic.

It is important to emphasize that trans-robotic mentality does not replace robotic mentality. It is like the discovery in mathematics of irrational numbers. The rational numbers are still there and just as important as ever, but now they are supplemented with a new kind of number. Likewise, the robotic mentality base (which never goes away) continues to function within organisms even as trans-robotic mentality emerges develops in evolution. Consciousness emerges from, and is utterly dependent on, trans-robotic mentality.

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