Symphony of Matter and Mind

Part five

Technologies of the Mind

The Brain as a High-Tech Device

Chapter synopsis:

1. Solving the Hard Problem of Consciousness.

If we say that the Mind is immaterial, we do not have any issue: we cannot study something nontangible. If we say that the Mind is material, we have to show how it physically works. Easier said than done. That is why one of the modern philosophers, David Chalmers, called it 'the hard problem of consciousness.' Another philosopher, Joseph Levine, noted that materialistic theories of consciousness so far could not explain the existence of qualia (subjective experience) from the physical point of view, so the explanatory gap remains. The chapter summarizes how the Teleological Transduction Theory (TTT) that the author started to develop in the previous volume of the series aims to cover the gap and proceeds to the hypotheses about what qualia are physically and how they are produced by the brain technologically.

2. Qualia Creation Technology.

The term 'qualia' has acquired a mystical meaning thanks to some modern philosophers. TTT takes the physical approach that stems from the etymology of the word 'quality.' The brain does not only measure the signals of the world answering the question of how much of this or that parameter is in a signal but creates signal representations answering the question of what kind (qualis) of a signal it encodes. This chapter offers hypotheses about the physical nature of the representations created by our brain and of a mechanism that allows it to combine them into a unified model of reality while keeping them differentiated. It also gives a detailed physical and physiological account of the qualia creation technology implementation.

3. Signal Identification Technology.

The Mind creates a model of the world consisting of representations as data sets about signals. Theoretically, a signal and a set of data about it can coincide. But the brain is a practitioner that does not have unlimited energy, time and space to pursue the impossible and pointless mission of creating a map equal to the territory. It does not copy a signal but reconstructs it. For that, it needs to measure the important parameters (direct task). But the brain cannot know what parameters are important if it does not have an idea of what is being measured. The reverse task of signal reconstruction is about identifying the signal. Of course, it is impossible to answer the second question without dealing with the first one. But without answering the second the answer to the first one does not make sense. The chapter shows how the universal algorithm of the Mind proposed in the previous volume elegantly solves the direct and inverse problems.

4. Technology of Overcoming Physical Limitations.

This chapter is about how the brain solves an obvious technological problem: the inclusion of a potentially infinite world of signals into a limited volume of channels for their reception and processing, as well as storage in a limited volume of a substrate as a carrier of encoded information. In general, the nervous system's entire evolution can be called a process of overcoming the above limitations. The chapter contains descriptions of solutions and provides examples of how the physics of brain technologies are manifested in the physiology of specific nervous system elements. It also gives a mathematical model of the Mind's algorithm showing how it performs the creation of the reality model with constant updating based on incoming data and the removal of part of the accumulated information to prevent possible overload of signal processing and memory systems.

5. Memory Technology.

Representations of signals of the environment are not only created by the brain but stored in it. Our memory has a 'magical' mixture of high capacity and precision, differentiation and integration, sequential and parallel processing, layering and associativity, stability and flexibility, speed and efficiency, dynamism and fault tolerance. What is the secret of the physics and technology of our memory that would explain its features that are so far unattainable to artificial technologies? A physical explanation of all these 'magical' properties of our memory is required. The chapter contains the hypotheses on how our memory works and reveals that the properties of our memory are built into the physics of representations.

6. Neural Code Transmission Technology.

The chapter suggests a new look at brain circuits. The old idea that they are a bundle of wires that transmit 'spike trains' of electrical impulses is technologically simple. Still, it leads to conceptual dead-ends and contradicts the reality of the brain's complexity, speed, and efficiency of information flows. The wrong idea about the code leads to a mistake when dealing with the question of transmission. Building on the Symphonic Neural Code hypothesis proposed in the previous volume, this chapter unravels the complex topology and morphology of neural pathways and explains the mechanism of high speed neural communication.

7. Movement Control Technology.

The nervous system specializes in controlling the body, organizing purposeful movement, and manipulating objects in the environment. How does it perform the function? In a nutshell, the picture of how the nervous system controls the body looks like this: commands are transmitted from top to bottom, and reports are received from bottom to top. The fundamental question is how they are formed and transmitted. There is another issue that needs to be resolved if we want to understand how the brain controls the body's movements. It can be called the 'centipede problem' — managing a massive number of motor effectors quickly and efficiently. How does a living system combine multiple parameters and reduce all these degrees of freedom to a state of controllability? The old paradigm says that the brain controls the muscles and joints. It can be called the 'puppet on the strings' model. It is a technologically simple idea but it does not correspond to the reality of the complexity and speed of our movements. Moreover, such a linear scheme is not able to solve the 'centipede problem.' The chapter contains novel hypotheses about the algorithm and physical mechanism that solves the riddle of movement control.

8. The Universal Processor.

This chapter continues the theme of the effectiveness of brain technologies. The main attention is paid to the plasticity of the neural network as the ability for dynamic structural and functional restructuring, if necessary. Elements of the system have specialization, but are largely interchangeable. The brain is a universal processor. The examples of its high plasticity given in this chapter are explained within the framework of the TTT hypotheses about the physical nature of subjective experience.