Symphony of Matter and Mind

Part seven

Inner Universe

The Mind as Reality Modeling Process

Chapter synopsis:

1. Modeling Principles.

Within the Teleological Transduction Theory (TTT) framework the Mind is viewed as a process of environmental signals transduction into representations and combining them in a coherent model of reality as the basis for the actions of a living system in the environment. This process has physical laws and their embodiment in physiology. Using these universal laws living systems develop technological solutions to the problems they face when creating the reality model. These issues were considered in detail in the previous parts of the series. The chapter takes a 'bird's-eye' view on the general principles of modeling that lead to the optimal adaptation of a living system to the world it lives in and the preservation of its structural integrity.

2. Life as a Game with Incomplete Information.

Taking a concept from the Game Theory, this chapter shows that life is a 'game' with incomplete information. The game can be graphically represented as a tree, where the branches are possible moves, and the nodes from which they grow are possible situations in the game. At each node, the player has a set of possible moves. The optimal solution depends on the completeness of the player's information about the current situation. The fullness of the information depends on how much the player knows about the initial conditions, the previous development and the current situation.

The living system as a player does not always know on which node of this tree it 'sits.' It can only make probabilistic assumptions. Moreover, it does not have complete information about the rules of the game. Calculation in the game of life goes on a slightly different level than just the layout of options on a chessboard with well-known rules. Based on the TTT hypotheses offered in the previous parts, the chapter shows how the brain does probability calculations to maximize the general probability and the conditional probability avoiding an overload of counting all probabilities for all information.

3. Library of the Mind.

For survival, a living system must have a sufficiently accurate (adequate) model of reality, which it forms using chains of cause-and-effect relationships between signals and extrapolating them to a larger set of signals. Thus, it creates a generative model trained discriminatively. The generative model is 'loyal' to all information, but there is a danger of losing necessary and

sufficient accuracy. The discriminative model cannot do without categorizing the input data and strives for maximum accuracy and detail, but there is a danger of flooding with data. The chapter shows how the brain manages to sort out the 'library' of the reality model, maintaining the balance between these approaches and avoiding the maladaptive state of the schism of the model and reality.

4. Reality Model as Probability Space.

The chapter describes the pitfalls that await the living system on the road to forming the reality model as a probabilistic structure and how it manages to overcome them. It should walk the tight rope between an impasse of determinism and the chaos of uncertainty. The reality is a multidimensional state space, and modeling it is not a trivial task. The chapter shows how the brain copes with the job. It describes it as a neutral transducer of stochastic signals that samples them as often as possible and over the maximum range, and, at the same time, a filter with 'prejudice,' a biased evaluative entity. The combination of these approaches makes it possible to create a simultaneously stable and dynamic reality model.

5. The Probability Rating Matrix.

To settle the issue of incomplete information about the potentially infinite and dynamic environment and avoid the overload of 'embracing the immense,' the brain forms the reality model as the probability rating matrix. It attributes probabilistic weights to signals and integrates them into the overall adaptive picture of the world. It has to be satisfied with the necessary and sufficient likelihood, estimate the parameters based on the known results, and calculate the current posterior distribution. But it must strive for the maximum range of coverage, spend energy and time collecting data, and not be satisfied with the existing level of the prior distribution (current versions of the reality model). Otherwise, a living system risks facing high uncertainty in the incoming signal, which could be a potentially fatal surprise. The chapter offers hypotheses about the probabilistic approaches used by the brain to solve the problems of modeling reality.

6. Informational Pendulum.

The Mind cannot afford to remain in a fixed, calculated once and for all model. It must explain the world here and now but also be ready for changes. If a living system calms down and decides that everything is estimated and expected, it will sign a death sentence to itself. It has to expect surprises in a constantly changing world. Thus, in trying to reduce uncertainty, it faces the paradoxical task of looking for surprises. The chapter considers the process from the information technology point of view. It shows how the brain solves the problem of balancing between the poles of the extremes of zero and maximum information entropy.

7. Hallucinatory and Illusory Representations.

The previous volumes of the series considered the nervous system's normal operation. The fundamental approach is to determine how the mechanism works and then explain what happens when it malfunctions. Based on the TTT hypotheses about the physics and technology of the brain's normal functioning, we begin to look at pathological states. The chapter starts to explore the issue of how the Mind may form representations that do not reflect the physical

characteristics of the actual signals or are not connected with them at all. It offers a hypothesis about the difference between hallucinatory and illusory representations from the technological point of view by considering at what stage of the Mind's algorithm they appear.

8. The Mind's Eye.

This chapter describes the manifestations of how, under certain conditions of the technological chain functioning, the inner Universe breaks away from the outer one, ceases to be a 'map' that helps to navigate, and even turns into a trap that leads to dead-ends. The description of such states helps us understand the complexity of the mechanism and technology in the norm.

A healthy state is imperceptible. We do not notice the flow until we see deviations. As a deviation in the flow of consciousness, pathology can serve as a 'litmus test' for the manifestation of the mechanisms of internal processes. By taking specific clinical cases, the chapter offers a detailed account of what may happen when the technology of the Mind breaks.

9. Guideline for Determining the Norm.

We can often hear discussions about what the norm is and whether it exists at all. The previous parts of the series aimed to give an answer to the question of the norm in principle and show it from different points of view (physical, physiological, technological). In short, the position within the framework of the proposed concept is simple: the norm exists.

The brain's task is to create an adequate and adaptive model of the world for the living system to orient and survive in it. Any living system's reality model is individual due to the uniqueness of a combination of its phylogenetic and ontogenetic history. So, the norm is not some kind of an ideal and universal model. The norm is the ability of the system to exist and operate effectively in the environment. The final efficiency is measured by maintaining the integrity and vitality of a given system.

A personal model can remain subjective and, at the same time, be adequate to the environment. But is there a way to assess the norm or deviation from it if there is no absolute measure? To formulate the concept of the system's normal functioning, one must first determine what the system does, what its function is in principle.

The chapter returns to the clear and physically substantiated functional definition of the Mind proposed within TTT. It reflects eight technological stages of the Mind's algorithm. Their violations may be analyzed based on the study of the substrate elements that perform the corresponding functions. Thus, the chapter starts the movement from the currently prevailing symptomatic approach to real diagnostics of the Mind's pathologies.

10. The Altered States of Consciousness.

But before we move on to the description of the Mind's pathologies, as violations in the process of forming a coherent model of reality, it is necessary to consider the so-called altered states of consciousness (ASC). On the one hand, they are normal adaptive states. On the other hand, they are in the border area, which means they can help us understand certain aspects of pathologies. The chapter considers various levels of such states and shows at which technological stage of the algorithm they appear.

11. Way out of the Vicious Circle.

This chapter provides general hypotheses and detailed descriptions of the physical processes that lead to ACS. Thus, it solves the old mystery of similarity between these states and pathologies of the Mind. It also defines the border area between altered and pathological conditions.

Throughout the existence of civilization, there have been many attempts to answer questions about the pathologies of the Mind: from ancient versions about the intrigues of the Devil or the curse of God to modern hypotheses within the framework of psychology, psychiatry and neuroscience. However, it seems that the number of questions is only growing, and the answers remain mainly at the level of describing external manifestations and have not fundamentally advanced along the path to a physical and technological approach to internal processes. In other areas of medicine, such an approach is considered standard, and it has created a huge leap forward in the treatment of many pathologies previously regarded as incurable. When it comes to mental illnesses, we are still largely at the level of describing the ‘devilry,’ but we just use new words.

Based on the previous volumes dedicated to how the Mind works normally, this book builds the bridge to the next one dealing with pathologies and shows the way out of the vicious circle.