(This is a part of the book The Concept of Reality.pdf)

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2. Mind and Matter: Preliminary Notes

2.1. Introduction: a fundamental Defect

Can we understand the world?

"Absolutely not!" replies the current physics and provides seemingly irrefutable evidence: e.g. the double-slit experiment, which ostensibly resists any thinkable description, or Bell's inequality, which is supposed to rule out any local interpretation of the world, or the relativistic space-time conditions, which are considered as contradicting our *a priori* given ideas of space and time.

If the usual interpretations of these scenarios were indeed the only possible ones, then any attempt to find out what reality is and what it consists of would immediately fail, moreover it would even be downright foolish, because it would then be *proven* that our concepts are completely inappropriate for understanding reality.

Fortunately, it has turned out that this unpleasant view is wrong. In the First Part has been shown that not only the just mentioned but also many other paradigmatic physical scenarios can be interpreted conceptually in an insightful way, and that the single interpretations unite to an alternative picture of reality from which all absurdities have disappeared.

But even if now could be presupposed that we understand nature and that the known natural laws are true, the concept of nature achieved in this way would still be incomplete and profoundly unsatisfactory, because it would not contain the part of reality that we call *mind* or *spirit,* and moreover because – despite claims on the part of some philosophers and brain researchers – it is even *completely impossible* to unite mental and material reality in *one* picture within the currently prevailing scientific view of nature.

In the past, this incompatibility was of a purely philosophical kind. For Kant, it was possible to understand the contradiction between the certainty that we are part of nature and therefore completely determined by natural laws, and the conviction that we have a free will, as a consequence of the inconceivability of the *thing in itself.*

For us, this possibility no longer exists. Our knowledge about the relationship between neuronal processes and mental phenomena does not permit such a retreat into inconceivability. At the neuronal-mental interface – the brain – the grasp of the material nature and its lawfulness on the mental area is

so concrete, that it is no longer sufficient to reject the claim of natural science – or say: the explaining power of natural science – with general philosophical arguments. Rather we are confronted with the challenge of analyzing *where* the current scientific view of the mind is falling short, and to use this analysis as basis for the explanation of the relationship between mind and matter.

At the time when the natural sciences had only just received their Newtonian foundation, it seemed hardly possible that mind could result from interaction of material objects. Let us listen to what Gottfried Wilhelm Leibniz, who turned away from the atomic theory of his contemporary Newton because of this difficulty, had to say in his Monadology written in 1714: [1]

"17. On est obligé d'ailleurs de confesser, que la Perception et ce, qui en dépend, est inexplicable par des raisons mécaniques, c'est-à-dire par les figures et par les mouvements. Et feignant, qu'il y ait une machine, dont la structure fasse penser, sentir, avoir perception; on pourra la concevoir aggrandie en conservant les mêmes proportions, en sorte qu'on y puisse entrer comme dans un moulin. Et cela posé on ne trouvera en la visitant au dedans que des pièces qui poussent les unes les autres, et jamais de quoi expliquer une perception. Ainsi c'est dans la substance simple et non dans le composé, ou dans la machine, qu'il la faut chercher. Aussi n'y a-t-il que cela qu'on puisse trouver dans la substance simple, c'est-à-dire les perceptions et leurs changemens. C'est en cela seul aussi que peuvent consister toutes les Actions internes des substances simples."

(Moreover, it must be confessed that perception and that which depends upon it are inexplicable on mechanical grounds, that is to say, by means of figures and motions. And supposing there were a machine, so constructed as to think, feel, and have perception, it might be conceived as increased in size, while keeping the same proportions, so that one might go into it as into a mill. That being so, we should, on examining its interior, find only parts which work one upon another, and never anything by which to explain a perception. Thus it is in a simple substance, and not in a compound or in a machine, that perception must be sought for. Further, nothing but this (namely, perceptions and their changes) can be found in a simple substance. It is also in this alone that all the internal activities of simple substances can consist.)

Thus, in this section, which later became famous under the name "mill parable", Leibniz rules out that thoughts, feelings and perceptions could be created by "parts which work one upon another" (what today we would call "interacting particles"). But if these capabilities do not emerge from interaction of objects, then, he argues, they must be assigned to simple substances (which he calls Monades).

[1] English text: http://oregonstate.edu/instruct/phl302/texts/leibniz/monadology.html. (Translated by Robert Latta.)

How does the relationship mind – matter present itself today? Can Kant's antinomy between freedom and causality be solved by the knowledge about neuronal networks? Is Leibniz' mill parable still applicable? Are there any other substantial objections against the hypothesis that mind is generated by neuronal networks?

I take the following position: [2]

To the problem of free will:

The Kantian antimony is still valid. It cannot be solved without changing the paradigm of natural science that everything which happens is completely determined by laws – and it is irrelevant whether these laws are deterministic or "objectively" probabilistic. Under this condition, science and freedom are incompatible; from the thus seamlessly knotted universal net of causality, there is no escape.

Therefore, the assumption of freedom of mind is tantamount to a change or an extension of the currently prevailing scientific view of the world.

In chapters *3. Free Will* and *4. The altered View of Reality*, I will show wherein the illusion consists, which natural science hitherto has succumbed to; thereby, this illusion will be repealed. The possibility of free will is a consequence of this correction.

To the question of scientific describability of mental processes; the problem of the Qualia

Mental processes have an *information content* and a *feeling content*

The current scientific view of the connection between neuronal network and mind forces not only the surrender of freedom, it fails also in the explanation why mental states are *qualia*, i.e. why they have the quality of *sensation,* or the quality of *feeling* something.

The correction of the view of reality carried out in chapters 3 and 4 permits to understand mental features – perceptions, thoughts, consciousness – and also freedom of will. However also in this extended view, the *feeling content* of mental states is not included.

[2] At first, I will just outline my view in brief and only announce the solutions. Later, all aspects will be discussed extensively.

The problem of the qualia is even more fundamental than the one of free will, because here not only the validity of the *scientific* description of reality is at stake, rather it is about the question whether and to what extent the possibility of a description of reality is given *at all.* The definition of the notion "red" cannot depict the mental state *red* – i.e. the sensation *red* –, and neither does a video or an equation of the neuronal activity which brings forth this sensation, and the same applies to any kind of description or illustration. The sensation *red* is not contained in *any* description. Thus, it represents an *irreducible* being, which cannot be *described* but only *experienced.*

As long as it is not cleared up, why the sensation *red* – or any other sensation – nonetheless can be understood as *natural* being, we do not know if mental phenomena do not contradict our concept of reality, and moreover, we can not even be sure whether we do not completely miss in our naturalistic model assumptions what reality *actually* is.

Conversely, the attempt to establish mind as basis of reality is devoid of any foundation. Everything we know about nature, we owe the natural sciences that are devoted to the investigation of material structures and processes. In contrast, the assumption that not matter but mind is the basic principle, has to date produced nothing other than speculation. Rather, all experiences clearly indicate that matter – or whatever one might call the kind of existence, which can be described by science – is a necessary condition for the occurrence of mental phenomena.

In chapter *5. Qualia* will be cleared up, what can and can not be achieved by descriptions and why this is the case. The difference between material and mental entities will be analyzed. The results of this analysis permit to understand qualia as states of the evolving nature.

<u>Are there other substantial objections against the hypothesis that mind is generated by neuronal networks?</u>

No. Our knowledge about information processing and representation in neuronal networks has progressed so far that there is no longer room for fundamental doubts about this hypothesis.

(It must be cleared up, however, in what kind of relationship reality and representation stand. This will also be carried out in the 5th chapter.)

Therefore, if the attempt is successful, to substantiate – on the basis of the scientific worldview and by logical reasoning – freedom of will and the existence of the qualia, then all ostensibly insurmountable problems are eliminated, which so far have prevented the integration of mind and matter. Then both

phenomena can – without the use of exotic additional assumptions – be thought together in one concept of reality, without having to lose their essence due to this union.

For now, this brief outline of the problem of the relationship between mental states and neuronal processes is sufficient.

I leave the final word of this introduction to Erwin Schrödinger, who, like no other, has recognized the two main problems of knowledge based on modern science: the failure of the interpretation of physical – mainly quantum mechanical – circumstances and the failure of the attempts to integrate mind into the scientific worldview.

Schrödinger writes:[3]

"Speaking without metaphor we have to declare that we are here faced with one of these typical antinomies caused by the fact that we have not yet succeeded in elaborating a fairly understandable outlook on the world without retiring our own mind, the producer of the world picture, from it, so that mind has no place in it. The attempt to press it into it, after all, necessarily produces some absurdities.

Earlier I have commented on the fact that for this same reason the physical world picture lacks all the sensual qualities that go to make up the Subject of Cognizance. The model is colourless and soundless and unpalpable. In the same way and for the same reason the world of science lacks, or is deprived of, everything that has a meaning only in relation to the consciously contemplating, perceiving and feeling subject. I mean in the first place the ethical and aesthetical values, any values of any kind, everything related to the meaning and scope of the whole display. All this is not only absent but it cannot, from the purely scientific point of view, be inserted organically. If one tries to put it in or on, as a child puts colour on his uncoloured painting copies, it will not fit. For anything that is made to enter this world model willy-nilly takes the form of scientific assertion of facts; and as such it becomes wrong."

So much for Schrödinger's view of the fundamental deficiency of science in the description of mental phenomena.

I agree with him. Now, however, Schrödinger means that, due to the fact that consciousness cannot be integrated into the current scientific worldview, it must be concluded that mind is not generated by

[3] Erwin Schrödinger: *What is Life?* and *Mind and Matter,* Cambridge University Press 1967. Chapter 4.

matter and that it exists in a way which cannot be realized by natural science: not, as we believe, as individual mind, but as a universal spirit, as it is seen in the Far Eastern tradition. [4]

This is also the reason why I let Schrödinger have his say in so much detail: not because I share his view (which I certainly do not) but because he has left, due to the failure of the explanation of the mind from its material conditions that seemed inevitable to him, the field of rational thought and judgment – like many other great thinkers before and after him – and because his and their mental aberrations testify, what the consequences are of the enduring lack of insight into the relationship between mind and matter.

As long as this insight is missing, it will always be the very ones who most clearly recognize the problem, who are exposed to the temptation to seek salvation in untenable speculations, not other than it has happened in the epistemological area, which has been opened to irrationality by the failure of the interpretation of quantum mechanical circumstances, and where now rules jesters license.

Indeed applies quite generally that any incompleteness of the scientific explanation of the world represents an exit from the field of rational thought. The most popular exits, however, are in any case these two: quantum mechanics and spirit. More and more scientists, mystics, and followers of all religions, but also just "modern thinking" average citizens huddle there, to escape from the futile effort of reasoning into the nirvana of nonsense and there to show off their tangled round dance.

Note

There is an important difference between the question: *Does free will exist?* and the question: *How can qualia be explained?*:

In the case of qualia, there is a real defect in our understanding of reality, which cannot be disposed of within the framework of the current scientific modeling. Thus, from the fact that qualia exist and that each quale is an irreducible being, follows necessarily that the current scientific view of reality is incorrect or incomplete.

This is different in the case of freedom of will. It is not necessary that free will exists. The assumption that it does not exist, does not lead to contradictions. Therefore, the fact that by the current natural

[4] In the same chapter.

science the existence of free will is ruled out, does not represent a *logical* proof for a defect of the presently prevailing scientific worldview.

However there remains massive discomfort: the elimination of free will would mean that we are no longer authors of our actions. Our free will would then be an illusion – in fact we would only act according to laws, by which, though we do not know them completely, we are determined, just like planets by the law of gravitation. With this, also the concept of responsibility would disappear. A being whose behavior – like the motion of a celestial body – is merely a consequence of the law by which it is determined, is not responsible for its actions. [5]

2.2. Overview on the next Steps

In what follows, I start from the premise that *mind* is a *natural phenomenon,* produced by neuronal networks of sufficient complexity. I will show that it is free, despite its inclusion in the causality of nature, and that qualia are obvious elements of a consequent view of reality.

Thus, the explanation has two stages:

1. The substantiation of the *freedom of mind*, without which – as just mentioned – we would not be authors of our actions.

2. The substantiation of the fact that mental states are always *qualia,* that is to say they have a subjective feeling content accessible only to the person (or being) who experiences it.

This schedule is imperative, because, on the one hand, the argumentation for the existence of the qualia is based on the one for the existence of freedom; on the other hand, however, both

[5] Occasionally, brain researchers argue that concepts such as responsibility or guilt anyway should be retained because of their importance in the social context. Here, however, the strangeness of theories that consider mind to be determined by natural laws can be seen clearly: If responsibility and guilt are not mental but neuronal phenomena, then also argument and will must be neuronal phenomena. If the causal connections are located in the neuronal layer and not in the mental area, then a reason cannot be a reason and an act of will cannot be an act of will. Nobody has ever a choice – whatever happens always happens due to physical causes. Wanting something or arguing for something is therefore meaningless. Determinists who believe they argue are subject to a self-deception.

argumentation scenarios are independent from each other to such an extent that each of them must be considered on its own.

The objective of this two-stage thought train is nothing less than a new view of reality. Therefore I will not content myself with these meager notices, but at least give an overview with some remarks about the sequence of argumentative steps and outline the associated circumstances in a little more detail.

Free Will and the Completeness Axiom of Science

The current scientific view of nature can be characterized by the following assumption – let us call it A_{N_0}:

A_{N_0}: ***Everything which happens follows from universally valid laws of nature and initial conditions.*** [6]

However, what in a defined area of reality – in a "system" – happens is in many cases not only determined by universal laws of nature, but also by further laws, that apply only in certain systems. [7]

This is easily demonstrated by the example of neuronal networks:

The description of the dynamics of a neuronal network refers first and foremost to the *structure* of the network and not to the details of the physical and chemical processes. Each brain researcher will conceive the neuronal network as a *cybernetic* system and not just as a physical-chemical one.

Considering the network as a cybernetic system permits even to refrain entirely from the type of the physical realization. This means, that here, in addition to the natural laws, another kind of laws determines the course of the neuronal dynamics, which might be called *laws of structure* or *laws of form.*

The same applies to the single neurons:

[6] With respect to quantum mechanics: *the probability of any event follows from …*

[7] This is an issue of fundamental importance. In the following two chapters (*3. Free Will* and *4. The altered View of Reality*), it will be discussed extensively.

Neurons are systems where a lawful relationship between input and output exists. This *neuronal input-output law* relates to the form and structure of the neuron. In this way, neurons *interact* with each other, not other than e.g. electrically charged particles stand in electromagnetic interaction with each other.

Thus, the neuronal input-output law can be regarded as *law of interaction of neurons*.

It is a law, which applies only to neurons and which occurs in addition to the natural laws. The mathematical formulation of the law is *independent of its physical realization*.

In order to take into account the existence of such specific laws that apply only in certain systems, the assumption A_{N_0} must be expanded to the assumption A_N:

A_N: ***Everything which happens follows from laws and initial conditions***.

For the description of a system, the laws are brought into the form of specific equations. Equations are quantitative relations between variables. Initial conditions are the values of these variables at a specific point in time.

Therefore A_N means, that, for every area of reality, there is a system of equations that contains all information that is required for a complete description of this area. Thus, in this sense, any area of reality can be mapped onto such a system.

For this reason, I will call A_N the ***Completeness Axiom of Science***.

A_N contains two presuppositions:

The first presupposition concerns the laws. The expression "follows from" is only justified, if the equations that correspond to the laws provide an *algorithm,* that is: a procedure, which permits deriving and calculating future events from the present conditions through the application of defined rules.

The second presupposition concerns the initial conditions. If the equation system should contain in fact *all* information about reality, then it must be *infinitely precise.* But of course, initial conditions are never available "infinitely precise": neither is it possible to measure a system with infinite precision nor can any system completely be separated from its environment. (Thus, in any case, the whole universe would have to be taken into account.)

Moreover, already writing down numerically with infinite precision the value of one single variable would in most cases require infinite time. [8]

Therefore, A_N is not a statement about an actually existing equation system but about a purely mental construction.

Does A_N then represent a meaningful statement at all?

I think yes. A_N reflects the conviction that *nature itself is an algorithmic system,* which means: it produces the future from the conditions given at a specific point in time through the application of defined rules, and that this lawful process can *in principle* be reproduced by a description system – even if this reconstruction, due to the above mentioned restrictions, is only approximately realizable.

To consider A_N meaningful requires only two assumptions that actually appear obvious:

The first assumption is that the variables *have* exact values at any point in time,[9] and the second assumption is that nature executes the algorithm by which the future is produced with these very values. Both assumptions are not challenged by the fact that *we* are neither able to write down these values within a finite time nor to execute the algorithm using them.

Let us return to our subject:

After what has just been said, from the scientific point of view it must be possible (in principle) to map neuronal networks onto a system of equations, such that the temporal evolution of the neuronal network corresponds to the temporal evolution of the system of equations, i.e. at any point in time the actual values of all variables would be equal to the (in principle) calculable values. Since this equation system is actually never available, in practice one must be content with approximations, e.g. by considering only the interactions of large ensembles of neurons or by directing the attention only to a limited number of neurons. The assumption A_N guarantees, however, that this approximations do not

[8] One could also ask if it can be presupposed at all that nature itself obeys its law with infinite precision. This question, however, would only be justified if nature would indeed *obey* its law. According to the considerations of the first chapter, however, nature does not *obey* the law, but it *is* the law.

[9] Quantum mechanically, this means (as ever), that there is a definite probability distribution of possible measurement values at any point in time. In my interpretation, which contains hidden parameters and is completely deterministic, this addition is of course superfluous. I just mention it to keep the argumentation on the freedom of will as far as possible independent of my own physical hypotheses.

necessarily lack anything "essential" – precisely because also the neuronal network is an "area of reality" that is *completely* determined by laws and can thus be mapped onto a system of equations; – and "completely" means that the equation system can reproduce *everything* which the network itself is capable of.

If all states of a network would actually be mappable in this way, then the according system of differential equations would also contain a description of the mental activity, which is produced by the network.

Under this condition, freedom of will would obviously be impossible.

Conversely, this means: From the assumption that we decide freely and according to our will follows necessarily, that the mathematical description of neuronal networks is *incomplete* – and it should be added, that it must be an incompleteness which goes beyond the above mentioned limitation due to the impossibility of infinite precision, that is to say an incompleteness which follows from the fact that *nature is not an algorithmic system.*

It is extremely important to recognize that the existence of free will does not depend on what *we* actually know or can know about a human neuronal network. Freedom of will does not only disappear if a lawful description is actually available, but already if the assumption is made that the *existence* of a complete mathematical description (of the kind defined just before) is possible, or, in other words, if it is assumed that the future is produced from the present in an algorithmic way.

Concretely: For the assumption of human free will, it is not sufficient that nobody knows exactly what a person will do, indeed it would not even be sufficient that this knowledge could never be achieved due to *technical* reasons; – for this assumption the much stronger condition must be met that such knowledge *is impossible due to logical reasons.*

Perhaps the following, slightly bizarre thought experiment may help to clarify the circumstances:

There is no doubt that the path of the planet Mercury is determined by the gravity of the bodies of the solar system. Let us now assume, Mercury possesses mind like us and is convinced that it has free will and chooses its path freely and with good reasons. Then this would be a self-deception of the planet, based on the fact that it does not know that its orbit is set by law.

We are certain that its path is determined, although the *exact* equation of the trajectory would never be available – indeed the positions and velocities of *all* bodies of the solar system would have to be

factored in – and though this equation, if it was yet available, would never be solvable.[10] The reason why we are certain is that we simply *know* that the planetary orbits are determined *exclusively* by the gravitational field. This certainty is itself not scientific in a strict sense, but it is of course a presupposition of science and an unquestionable element of the scientific worldview.

If our own mental activity were determined by laws in the same way as the path of Mercury by the gravitational field, then obviously we would be in the same position as the planet who considers himself free. We would just believe to act willfully, but actually we would still always carry out what we are prescribed by law. Though we would not know the law of our actions, it would still always be present and lead us. And our mind would then be – though only *in principle* and never in reality – mappable onto an equation system, would be captured therein and have lost its freedom.

Under this condition nevertheless to assume that we acted according to our will, would be as absurd as the claim that not only gravity guides the path of the heavenly bodies, but also *a many-armed cosmic monkey.*

Thus we have arrived at the conclusion that at most one of the two assertions is true:

1. Free will exists. 2. The Completeness Axiom of Science A_N is correct.

This is the current state of affairs; an unpleasant alternative.

On the one hand, the assumption of free will is of essential importance for our self-understanding and the meaning of our existence. On the other hand, it is completely unclear how the possibility of mapping a real system onto a system of equations and initial conditions could be excluded.

In the chapters *3. Free Will* and *4. The altered View of Reality*, precisely this question will be in focus:

Why is the Completeness Axiom of Science invalid?

It will be shown that a representation of the dynamics of neuronal networks by a system of equations and initial conditions is not possible, and indeed, as required, not for merely technical, but for logical reasons.

[10] "Solvable" means here and in the following, that a procedure exists by which future values of variables can be exactly calculated.

The proof is achieved through the derivation of the following proposition:

There are states of neuronal networks, whose formal representations are statements which are not derivable from any system of equations and initial conditions and which cannot be regarded as solution of such a system for any given time.

Thus, the Completeness Axiom of Science is wrong. Any formal description of nature by a system of equations and initial conditions is necessarily incomplete.

The scientific paradigm must be corrected.

The argumentation which is necessary for the proof of this assertion is sufficient for the substantiation of the autonomy of mind and the existence of free will. But this substantiation represents only a necessary and not a sufficient prerequisite for the understanding of mind, because still the explanation is missing what mental states *actually* are, that is: *qualia*.

The Problem of the Qualia

Nothing would be easier than to construct a robot which could associate the frequencies and frequency-mixtures of light that we perceive as red, with the word "red". It could be programmed in such a way that it says "red", if its optical chip gives it the information that such a frequency-mixture is present, while at the same time it directs its arm to the respective subject and moves towards it. For this performance, not even artificial intelligence would be required.

It would then be perfectly clear that the robot – I'll call it *John* to be able to come back to it later –, though it has the **information** which is necessary for the definition of "red", is still lacking the **sensation** *red.*

Red as quale – just that characteristic color sensation that *we* have when we perceive or imagine *red* – can never occur in the robot's simple program.

This example demonstrates clearly that a difference has to be made between *information* and *sensation.*

As a consequence, however, a series of questions arises, none of which has hitherto been answered – not even to some extent.

To name a few:

If a human experiences the sensation *red,* then the description of his/her neuronal activity contains the information without which the sensation could not exist. How is here the relationship between information and sensation? What is it which makes the sensation possible?

What is the difference between the state of a system, which contains only information, and a state, which brings forth a sensation?

Can artificial neuronal networks have sensations?

Obviously, the ability to feel anything is connected with the complexity of the neuronal networks that have evolved over the course of evolution. So the question arises:

On which rung of the evolutionary ladder turns information into sensation? Where becomes the automaton a sentient being? At the invertebrates? At reptiles? Fish? Birds? Or only at mammals?

By what does this change of the essence of being occur?

One can also ask more concretely:

Do bees perceive colors? Is their world really *colorful*? Or are they just machines that respond to light-frequencies?

Do crabs feel pain? Or are they just reacting to stimuli?

"Complexity" is often used as a magic word, as if it would be evident that, with sufficient complexity of a neuronal network, sensations would occur just "by themselves". This is of course nonsense. Complexity is just a necessary condition, but nothing else.

The same applies to the popular outside-inside discrimination. It is claimed, that information and sensation are *the same*: exactly that, which from the outside – by an observer – is seen as neuronal activity, is from the inside – by the "system" itself – experienced as sensation.

But also this assertion is no explanation, and moreover, it is even wrong, as will turn out later.

Thus, the central question remains: *What are qualia? In which way can qualia be understood as natural states?*

The formal-logical argumentation, which in chapter *3. Free Will* served for the substantiation of the freedom of will, is not sufficient here, because the explanation of the qualia is based on the difference between *actually existing objects* and their *representations (descriptions),* which can only be defined in a metaphysical manner.

Starting from this premise, one achieves, by means of some simple metaphysical conclusions, a broader understanding of being that contains both the scientifically representable reality and the reality of mental states.

Thus the three worlds – the material world, the world of the mental processes and the world of the discoveries and creations of mind – can be brought under one concept.

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3. Free Will

Subject of the ensuing considerations is the *metaphysical* question of the possibility of free will.

Thus, we will not discuss psychological, sociological or other dependencies of volitional decisions, but solely the question whether free will is possible *at all* – provided that we live in a universe in which, according to contemporary conviction, *everything* is determined by laws.

3.1. Preparation: Justification of psychological and mental Concepts

At present, the assumption is widespread that mind can be reduced to neuronal processes. Let us denote this position as "neuronal reductionism." It means the following:

Although we experience mental states as agents of mental activities, we are misled by this perception – *actually* mental activities are pure epiphenomena of neuronal processes, by which they are totally determined. One could also say: mental phenomena are *nothing but* neuronal phenomena.

Under this condition, it might seem at first as if the description of mental activity by psychological and mental concepts – like feelings, thoughts, reasons etc. – was an inaccurate form of representation, which should only be used until a more precise representation by concepts of the neuronal layer is available. Only then we would indeed know what e.g. the mental concept "reason" *actually* means – it might be a local energy minimum of the dynamics of a region of the neuronal network.[11]

Let us investigate to what extent this idea of a possible elimination of mental notions and concepts is justified.

A necessary premise of neuronal reductionism is the assumption of the autonomy of the neuronal layer that represents the basis of the reductionistic argumentation. This means that one can speak of *neurons* and *neuronal processes* and need not resort to molecules, atoms or elementary particles and their interactions.

[11] The term "dynamics" refers to the temporal evolution of the state of a system. "State" means the set of the values of all variables of the system (quantum-mechanical: values of all simultaneously measurable observables) at any given time.

Can this autonomy indeed be presupposed? In some respect this seems so self-evident that one could consider it as a fact that does not require special attention: indeed one can *see* that neurons exist, that they interact, that the motion of molecules is determined by the *form* of the neurons – and therefore a description of the neuronal activity based on the terminology and the models of neurophysiology and neuro informatics seems adequate.

From the reductionist point of view, however, using structures as basic elements of the description which by themselves are already aggregates of simpler components can not at all be considered a matter of course. In any case the reductionist must reason why the elements of his/her description (neurons) can themselves be complex and why he/she does not need to use *really* elementary constituents.

As main reason – and we can assume that a reductionist would argue in the same way – for the adequacy of a description on the basis of neurons the following can be asserted:

Neurons interact *as neurons* with each other, that is to say: neuron assemblies can be understood as cybernetic systems that are completely determined by the relations between their elements, such that for a description of the structure and dynamics of states of neuronal systems it is irrelevant that they are *actually* (from the reductionist point of view) molecules (or atoms, or elementary particles). The kind of physical realization is negligible (– which is also a necessary premise for computer simulations of neuronal processes).

We now focus our attention on a higher level of complexity: we consider the layer of *mental states and processes*. We define "mental states" – in accordance with the usual definition given by brain researchers – as *global patterns in space and time* of the neuronal network, where many areas of this modular constructed network are simultaneously activated which represent different aspects of facts and circumstances of a situation and are connected with each other as long as the state persists.

Without going into too much detail, some areas can be mentioned: modules which belong to perception and represent the (actual or visualized) scenic aspects, various modules in the front region of the brain which serve for the analysis of complex interrelations (e.g. for the evaluation of the social consequences of an action), motor modules, the speech center etc. – however in any case also parts of the diencephalon, which connect the neuronal system with chemical regulatory systems that modulate the behaviour and are indispensable for the intentionality of mental states.

Now follows the essential step for the justification of psychological and mental concepts:

Everything that can serve as argument for the adequacy of a description of the activity within the brain based on neurons and neuronal processes and not on molecules (or atoms, or elementary particles), can serve as well – identically or analogously – as argument for the adequacy of a description of mental states and processes by mental or psychological concepts and models – like e.g. "perception" or "thought" – and not by neuronal ones.

Just as neurons interact *as neurons* with each other, also mental states interact *as mental states* with each other; In the same way in which can be asserted: the output of the neuronal module A causes the state of the neuronal module B, it can also be asserted: the mental State B is the consequence of the mental State A – precisely as it happens e.g. in the case of thought trains.

Thus mental states are interconnected *with each other*, they cause each other, they determine their chronological succession – in short*: they form a layer of reality, which is just as self-dependent as the neuronal layer.*

Just as the description of the neuronal dynamics permits to abandon the material condition of the cybernetic elements (the single neurons) – that is: that they are aggregates of molecules –, also the description of the dynamics of mental states permits to abandon the material condition of the cybernetic elements (the single mental states), that is: that they are global neuronal patterns.

In short: *Mental processes have the same right to a specific independent description as neuronal processes.*

Therefore, statements about mental circumstances – like the argument, which is usually held up by philosophers against reductionists, that in the mental area *reasons* apply and not *causes* – are justified in exactly the same way as statements about neuronal circumstances – like the assertion that an idea becomes a memory due to the fact that the connections between simultaneously active neurons are strengthened.

Thus we have arrived at the following conclusion:

If the neuronal layer of reality can be described and understood as cybernetic system, with a specific structure of its own and a neuronal dynamics based on it, then the same applies to the mental layer: it can also be seen as cybernetic system that has a specific structure from which in turn follows a specific *mental* dynamics, that is: a sequence of mental states, whose regularities relate to the structure of the space of mental states.

So if it is justified to express neuronal states through concepts and relationships which follow from the assumption that neuronal activities must be considered as elements of the cybernetic system of neurons, then it is also justified to express mental states through psychological or mental concepts and relationships which follow from the assumption that mental activities must be considered as elements of the cybernetic system of mental states, that is: the mind.

This, however, means at the same time:

If the assumption were correct that mental descriptions must be replaced by neuronal ones, then this assumption would abolish itself, because then the neuronal description would have to be replaced by the molecular one, this one in turn by the atomic one, and so on. The process of reduction can only end when the fundamental layer is reached – unless there are special reasons for the independence of a specific layer.

But such reasons cannot be found for any layer of reality: what speaks for the independence of *one* layer applies equally to all others.

Though this justification of the specific autonomous description of the mind by mental notions and concepts is *conditional* – it applies only if there is, besides the elementary description, also *any* other appropriate description –, this does not represent a serious limitation because it would be absurd to renounce all other descriptions.

Thus, the just performed train of thoughts is a complete justification of the mental description of mental states. However it does not contain any explanation how this description can be fitted into a scientific context, and for this reason it was merely intended as an introduction, as a preliminary exercise, which is capable of calling current thought patterns into question and is therefore appropriate as preparation for the ensuing analysis of the same scenario.

3.2. The Path to the Reality of the Mind over seven Stages

In order to arrange the following train of thought as clearly as possible, I will highlight the various stages as headings.

Starting point of the analyses is the assumption A_N, which in 2.2 was denoted as *Completeness Axiom of Science.*

A_N: ***Everything which happens follows from laws and initial conditions***.

At first, a note about the prerequisites:

From the physical point of view, reality consists of objects that interact with each other. Initial conditions are the values of the variables of a system – e.g. the positions and momentums of all particles – at any given time, laws are mathematical relationships between these variables, that is: equations.

Here is a more extensive formulation of A_N, by which the assumption of the (possible) structural identity between reality and description is emphasized:

A_N means: *The **information**, which is present **in nature** and which the temporal development of a system depends on, is **completely** contained **in the initial conditions and equations of the system**. In the same way as in the reality the future follows from the present, the future values of the variables of the equation system follow from the present ones. The system of equations maps the laws, by which is determined how the future is generated from the present.*

The formulation "initial conditions and law" gives first the impression that "the law" is a kind of input-output machine, which, if it receives the exact initial conditions as input, will then produce the correct values (probability distributions) of all variables at any given time. Let us denote this provisional conjecture as

Position 1:

*The initial conditions are singular, the law is general, which means: the initial conditions are entered **once** into the law-machine (inserted in the system of equations), and thereafter the law-mechanism contains the desired result **for any point in time**.*

This expectation is confirmed by some simple classical examples such as a swinging pendulum, or a planet that circles around its sun, or the case of two gravitating bodies which – if they are not disturbed – will perform their elliptical dance for eternity (at least in the Newtonian approximation).

Let us stay with the case of gravitating masses, whose dynamics is determined by their self-generated gravitational field.

In the case of more than two bodies, the situation changes in an essential way. The differential equations are no more integrable, and therefore it is no longer possible to understand the law as mechanism that produces for any input the according output.[12] Instead numerical methods must be applied.

How is to be proceeded in the case of – just to name any sufficiently large number – 1000 bodies that move relative to each other and are bound to one another by gravity?

If the initial conditions, that is: the positions and momentums of all bodies, are known at the time t_0 and should be calculated for a later time t_1, then the time period $t_1 - t_0$ must be divided into intervals; – into how many depends on the desired accuracy: the better the approximation, the smaller the intervals.

One starts with the initial conditions of the first interval and calculates the positions and momentums of all bodies at the end of this interval. They represent the initial conditions of the second interval. Then one repeats the same procedure for any further interval and, in this way, achieves at the end the desired result with arbitrary precision (apart from possible instabilities, which, however, is not relevant for the subsequent train of thought).

What has changed against the previous situation?

Now, the initial conditions no longer appear as incipient one-time requirement for the law-mechanism but as continuously recurring requirement which accompanies the act of information-gathering permanently. If one maintains the claim that the description provides (in principle) *all* information that nature itself needs for its temporal development, then actually initial conditions and law become completely equivalent, because in order to make this information available, the duration of the calculation intervals would have to go to 0.

With respect to the calculation of the path of any single body, the initial conditions turn into *boundary* conditions that change differentially with time – exactly as the position and momentum of the body itself.

[12] In the case of three bodies, there are solutions in the form of convergent series. However regarding the argumentation presented here this is irrelevant – we are not interested in special cases of small numbers of interacting bodies, we consider the question what changes at the transition to *very many* bodies

Thus, the system is governed by *feedback:* the local changes (of the positions and momentums of the single bodies) affect at the same time the boundary conditions (the global circumstances), and accordingly also the effects change, which the gravitational field exerts on the single bodies, that is: their accelerations.

The first assumption must be corrected then, and we get to

Position 2:

Law and initial conditions are equivalent. There is a permanent feedback between global structure and local changes.

Already by this simple first step from position 1 to position 2, the common idea of causality "from below" or "bottom-up" – i.e. the idea that everything is determined at the layer of "elementary particles" has proven wrong. It fits only ideal cases, which are never realized. In real cases, from the causality "bottom-up" alone follows indeed nothing at all; in order to produce information about the future, it needs to be connected with the causality "from above" or "top-down".

The concept of *determination at the layer of elementary entities* must be replaced by the concept of *feedback,* that is: *interaction between local and global conditions*.

For the next step, we change into a different scenario. We consider an oscillating membrane which consists of a very large number of particles that are bound together by electromagnetic forces. At its periphery the membrane is fixed such that it is under tension.

Here we find

1. A natural law: the equations of the electromagnetic interaction.
2. Initial conditions: the positions, momentums and charges of the particles at a specific point in time.
3. Boundary conditions: the *form of the edge of the membrane,* by which its possible oscillation states are determined.

Compared with the previous scenario, something crucial has changed. Previously, the positions and momentums of the particles at the beginning of each time interval represented the initial conditions for the next calculation step. We called them *varying boundary conditions* or *global structure.*

But the boundary conditions referred to in point 3 do not correspond to these boundary conditions of the previous scenario. Instead applies that now the global structure itself is restricted by further conditions – let us call them *boundary conditions of higher order* – in such a way that it obeys a separate, new law: the *oscillation law of the membrane*. The conditions mentioned in point 3 are these boundary conditions of higher order.

The oscillation law of the membrane is not a natural law in the usual sense. It is also not deducible from natural laws. In order to provide a description that contains all information, it must be added *as such* to the natural laws that apply to this scenario.

The independence of the oscillation law from the natural laws is proven by the fact that, for its mathematical description, the physical realization can be dispensed with.

The assertion that there appears *an additional law*, might at first seem strange. Is it not still just the electromagnetic interaction, which determines the movements of the particles and, with it, the movement of the membrane? Is the oscillation law not just a comfortable form of representing the dynamics of a particle-constellation that is *actually* determined by electromagnetism?

The answer is *no.* The electromagnetic interaction represents only *one* prerequisite. But for the complete description, here – as well as in the previous scenario and in all other cases – not only the law but also the *initial conditions* at any given point in time are required, in other words: the *global state of the system.* And while previously it was necessary to subdivide the whole process from start to finish into intervals and to determine the global state for all these intervals anew, it is now possible, due to the *additional law,* to set up an equation that can be solved analytically.

This means: The new law is the ***dominant*** *law. It determines the global and with it also the local dynamics. The natural law is subordinate: the electromagnetic interaction fits into the requirements of the oscillation law.*

But has not the whole scenario yet originated in accordance with natural laws, such that also the boundary conditions, which are structuring here the global dynamics in a lawful way, ultimately can be derived from natural laws and initial conditions?

Again no. The attempt, to disproof the assertion that now the global dynamics obeys a *new* law by drawing on the past, fails, because in any case, no matter how far back one goes, one has to start with law *and initial conditions*, and then – according to what has been said just before – due to the *ever-changing global conditions* it is impossible to derive the future.

Exactly this fact prevents the deduction of existing systems from natural laws and initial conditions and permits the occurrence of new laws. The natural laws alone do not offer this possibility – they remain always identical. The global conditions, however, which represent a second indispensable element of the organization of nature and its description, are open for the development of regularities, which occur in addition to the natural laws.[13]

This second step in our train of thought has brought us from the assumption that there are only natural laws to the assumption that the dynamics of the global states of a system is not only determined by natural laws but also by further laws that could be called (as has already been stated in 2.2) *laws of form* or *laws of structure.* To sum up:

Position 3:

Boundary conditions – or, more general: structural prerequisites – can have the effect that the global system-states are subject to laws, which take place in addition to the natural laws. These are laws of form or laws of structure. They are dominant and independent of the physical constitution of the system.

To perform the next step, we now turn directly to human neuronal networks.

The single elements, which they consist of, that is: the neurons, are systems that are comparable to the membrane of the previous scenario in the following way:

The constitution and the structure of the neuron are to be seen *as set of boundary conditions;* as such they determine the dynamics of the physicochemical processes that occur in the neuron, i.e. the dynamics of the system states. Analogously to the *oscillation law* of the membrane, also here a *new law* appears: the well-known *neuronal input-output law.* And also in this case, it is possible to disregard the physical realization.

Position 4:

Neurons are systems whose (internal) dynamics is governed by a law of structure – the neuronal input-output law. Also the dynamics of the neuronal network as a whole follows this law. In this regard, the network is similar to the previously described gravitational scenario whose dynamics was determined by the law of gravitation. The neuronal input-output law can be understood as interaction law of neurons.

[13] This argumentation will be completed in the next chapter.

With this, we have arrived at the layer of reality that is the subject of brain research:

The neuronal network is seen as a system whose elements are neurons and whose states are determined by the interaction law of neurons (the neuronal input-output law), in the same way as the states of physical systems are determined by natural laws.

The broad outlines of the dynamics of the network are directly observable. Several imaging techniques show which neuronal areas are active and enable thus insights into the functional topology of the brain. The knowledge of the activity and shape of neuronal structures allows – to some degree – even conclusions about the extent of the associated intellectual performance, particularly in the case of pathological limitations.

The question is:

Does the now reached layer of reality – the neuronal network as system that obeys the neuronal input-output law – already correspond to the layer of the mental activity?

The answer is *no,* and here is why:

Suppose we have the equation (or the system of equations) of a human neuronal network. (Even if this assumption is totally absurd, there is still no reason to rule out the *existence* of such a system of equations.)

Then we are in the same position as before in the case of the system with numerous gravitating bodies. We have *the law*: the system of equations of the network, and the *initial conditions*: the values of the variables by which the states of the individual neurons are defined – exactly as in the gravitational scenario the law and the initial conditions have been given.

Whoever now thinks that from law and initial conditions would already follow the further temporal development of the system, would be subject to the same mistake, by which the provisional *position 1* was characterized – that is: the erroneous assumption that the law functions as an input-output mechanism, where the initial conditions could be used as input, and which thereafter – without any intermediate steps – produces any desired information about future system states.

This assumption was wrong in the gravitational scenario, and it is also wrong at the neuronal network, because in both cases there is a *permanent feedback* between the global system state and the local changes, which are determined by the law *and* by the global state.

Let us again compare the gravitational scenario:

The changes in the variables of the bodies – the positions and momentums – result from the structure of the gravitational field, i.e. from the state of the entire system. The law of gravity can be applied to determine the paths of the bodies – however only for a (very) short period of time, because due to the local alterations also the field changes. This change must be taken into account at the next step. The changed field effects now alterations of the positions and momentums, which again represent at the same time a change of the whole field etc. The *singular initial conditions* turn into *variable global conditions*.

Due to this permanent feedback, it is indeed completely impossible to obtain information about the temporal development of the system by inserting the initial conditions into the equations and then applying a method for finding solutions. *Such a method does not exist.*

In the neuronal network, the circumstances are analogous. All elements of the system (neurons) are either directly or over a few intermediate steps connected with each other. The alterations of the variables of the neurons – number of synapses, connection strengths, degree of activation, frequency – are a consequence of the respective global system state, which means: the law (the equation system of the network) can be applied. But just as before, only information for a (very) short time period can be obtained in this way; the local alterations change at the same time the global system state, which in turn acts differently on the local variables etc. And – as in the gravitational scenario – from the existence of this massive feedback follows that there is no method for finding solutions of the equations of the neuronal network.

Position 5:

Due to the feedback between global and local conditions, it is not possible to calculate exact values of variables for any time point in the future.

There is no algorithm which leads from a known state A of the network to a future state B.

Thus it would be necessary, as in the gravitational scenario, to resort to numerical approximations, *unless* there are other laws, which, as in the membrane-scenario, determine the dynamics of the network *in addition* to the neuronal input-output law.

Thus we are faced with the next fundamental question:

Is the interaction law of the neurons – the neuronal input-output law – the only law which the system obeys, or are there further laws of the kind that previously has been called laws of structure?

In other words:

Is, as in the gravitational scenario, the interaction law of the elements of the scenario the only law, or occur, as in the case of the oscillating membrane, further laws due to *structural preconditions* – laws, that is, which determine the global system states?

The answer is simple. As follows:

"Mental states"[14] are defined as global states of the neuronal network, where many areas of the network are simultaneously activated and connected with each other. [15]

With this, the conditions are comparable to those of the oscillating membrane. The structuring of the network by the therein possible mental states can be understood analogously to the structuring of the membrane by its possible vibration states. In the case of the membrane, the edge represents the condition for the occurrence of organized global states, in the case of the neuronal network, the *form of the whole network* (more precise: of the state space of the network) represents the structural prerequisite for the occurrence of organized global states (patterns) of the network, that is: of mental states.

Position 6:

In addition to the neuronal input-output law, the neuronal network follows a further law: its dynamics is structured by the global patterns that are defined as "mental states". Their structuring function can be understood analogously to the one of global oscillation states of a physical system: like those, mental states are attractors of the global dynamics. (More to that in 3.4.)

[14] Here, I use the term "state" analogously to the term "oscillation state" of the membrane, i.e. synonymously for "spatio-temporal pattern". Thus, a mental state is extended in time – in contrast to a physical state, which relates only to a certain point in time.

[15] As a further condition must be assumed here that parts of the network are active, which have no specific function (so-called associative arrays). Only if that is the case, then the global states can also be mental states, and only then apply the following considerations. (At the end of 3.5, I will return to this point and again enter into it in the 5th chapter.)

The next step leads beyond the membrane analogy:

In the same way as it can be assumed that mental states are organized global system states, it is also clear beyond doubt that they refer to each other, so that they *form their own network*.

This means: While the transitions between the various possible oscillation states of a physical system are caused from *outside*, the transitions between the organized global system states of a neuronal network – the mental states – are part of the *internal dynamics* of the network.

The transitions between the global states – as well as the states themselves – cannot be derived from the neuronal input-output law: If the transitions were derivable, then also the whole sequence of the global states would be derivable, and then would follow that also the elements of this sequence, i.e. the states themselves, could be derived from the neuronal input-output law. However, as stated just before, they do not follow from this law but from a *new law of structure.*

Accordingly, to the mental states must be assigned *their own dynamics.*

In other words: Mental states relate *as mental states* to each other. They are connected with each other by a specific *mental* interaction, not other than particles are connected with each other by a specific physical interaction.

With this, we have now, without ever having had to leave the area of scientific model formation, systematically justified the assertions, which have already been presented in the previous section 3.1.

Here the repeat. It is at the same time the

Position 7:

Like neurons or neuronal modules, ***mental states are networked with each other, they cause each other, they determine their own temporal sequence****, in short:* ***they form their own self-dependent layer of reality.***

Just as the description of the neuronal dynamics permits to abandon the material condition of the cybernetic elements (the single neurons) – that is: that they are aggregates of molecules –, also the description of the dynamics of mental states permits to abandon the material condition of the cybernetic elements (the single mental states), that is: that they are global neuronal patterns.

ONLY NOW we have reached the layer of mental activities, that is: the mind.

Only by realizing that the global patterns of the network form a *structure of higher order*, mental phenomena *as such* can be integrated into the scientific view of the world.

Basically, the step from position 6 to position 7 is not a new move – it represents merely an analogy to the rising from molecules to neurons. It is another example for the fact that aggregates which consist of simpler elements in turn can form the components of a higher layer, which means: they can act as elements of a dynamic structure of higher order. In exactly this way, the global patterns of the network must be understood as elements of a higher layer of reality.

To the cursory glance, this fact could remain hidden, because this layer of reality is never present *as a whole*. Indeed the neuronal network does not contain the activation patterns themselves, but only the *construction rules* for these patterns. Therefore, of all possible mental states, only one at a time is realized.

While the neuronal network as a whole – as cybernetic system – exists at any time, such that its structure is (in principle) completely visible, the network of mental states cannot be observed directly.

As an example of mental activities, let us consider a *train of thought.* In our picture, this is a sequence of organized system states. Any thought is a pattern or already a sequence of patterns. In each case, only one of all patterns which represent the thought train is realized. It is active for a short time and then the change to the next pattern takes place. This subsequent pattern, however, can possibly be realized *in the same neuronal areas* as the previous one. Thus, at a resonance tomography, this transition would not at all be observable.

Therefore, if one aims at investigating the structural connections of mental states, then this cannot be carried out by observing an existing structure. Rather it is necessary, to consider a *virtual* space, which however (in principle) could be visualized by a model. Its elements would be mental states – ensembles of thoughts, feelings, perceptions etc. – and its structure could be indicated by arrows, which lead from any state to the possible following states, with information about the probability of each transition.

Thus, the structure and the dynamics of the mental activity cannot be visualized by any imaging technique. In order to gain an overview, one has to enter the virtual space of mental states.

Basically, imaging techniques can only inform about the activities and sequences of states of the network which are determined by the neuronal input-output law and by the functional architecture of

the brain, and *not* about the activities which are determined by those regularities that apply to the sequences of mental states, e.g. to trains of thought.

Thus it is understandable that in brain research, provided that it is based on imaging techniques, never conclusions, thought processes or insights are considered, which actually represent the true realm of the mind.

Let us look briefly at what has been achieved. How far have we come?

From our analysis follows the autonomy of the mind. It has been shown that mental activities can – and indeed *must* – be described *as such.* In doing so, we have not come into conflict with the scientific view of the world; on the contrary, the argument was referring only to scientific facts and methods.

With this, the description of mental phenomena by the terms that we use every day is completely justified. Thoughts are thoughts, reasons are reasons, decisions are decisions. That they can appear *as they themselves* and need not be *something different* is because they are not reducible to anything else. And the reason for that is simply the same as in the case of the oscillation states of the membrane: like these, also mental states obey an additional, new law and can therefore not be reduced to another, simpler layer of reality.

In short: the assertion is wrong that mental activities are *neuronal phenomena*, just in the same way as the assertion is wrong that the oscillation states of the membrane are *electromagnetic phenomena*.

Thus, mental phenomena are *new, irreducible phenomena,* whose independent description is not only justified but necessary.

It should particularly be emphasized that through the foregoing findings not only the autonomy of mental phenomena is justified, but that they permit also to understand mental states as *causes* of physical events. Now, a statement like: "This person acted in this way because he/she thought it right." is equally justified as the statement: "The red ball was pocketed because it was hit by the white ball at the correct angle." Both statements are appropriate causal descriptions of the occurrences in the respective layer of reality.

As a reminder: the justification consists of two facts. The first one has been revealed already at the transition from the first to the second position: regarding the future development of a system, the global state of a system is of equal relevance as the local conditions (as e.g. positions and momentums of particles).

The second fact is that there are systems, the global states of which are determined by laws that exist in addition to the natural laws. If this is the case, then the new law is dominant, and, accordingly, the global states dominate over the local conditions. Thus, it is appropriate to see them *as cause* of the local dynamics. In exactly this sense, mental states are causes of the changes of the neuronal variables and, with it, also causes of actions.

In this simple way is explained how "mind" acts on "matter".

Thus the mental states and processes themselves have become part of the causal nature, but not in the way they appear in the classic antinomy of freedom and causality, not as *caused* but as *causative*.

(Whether or to what extent they themselves are caused, will be answered in the next section.)

Also the emergence of *reasons* can only be understood if one considers the fact that mental states are networked with each other, so that they themselves represent elements of a further layer of reality, of a system of higher order, which has its own dynamics, that is: sequences of states that obey certain rules of their own. *Reasons* are examples of such rules.

However, in the foregoing considerations, important distinctions are missing.

For example, it is clear that not all states of neuronal networks can be regarded as mental states. Simple neuronal networks function like machines. They are completely determined by their circuits – that is: by the neuronal input-output law – and by their functional architecture. Thus it would be desirable to clarify under which conditions the used analogies and arguments apply. (In section 3.5, in the notes, I'll make up for it.)

On the other hand, our intention was to substantiate the *principle possibility* of understanding mind as natural phenomenon and to integrate it into the scientific world view, and exactly that is the result of our previous thought trains: they demonstrate that this possibility exists. Mind can be understood as an autonomous layer of reality, which cannot be reduced to any other, deeper layer (of neurons, molecules etc.). Therefore, psychological and mental concepts and notions are appropriate, and mental processes are causes of physical changes.

What is still missing, however, is the substantiation of the *freedom* of the mind. Though it is justified to regard decisions as mental phenomena, at the current level of our considerations it is still not justified to call them *free.*

3.3. The last Step: the Substantiation of Free Will

Before our view now the following scenario is laid out:

The neuronal network consists of several superimposed layers of increasing complexity.

The bottom layer – let us call it the *field of first order* – is that of **atoms** and **molecules**. They obey a law of nature: the *law of the electromagnetic interaction.*

Their dynamics (within the neurons), however, is governed by a *law of second order* (a law of structure): the *neuronal input-output law.*

The middle layer – the *field of second order* – is that of **neurons**. They obey a law of structure: the *neuronal input-output law,* which is also their *interaction law.*

Their dynamics, however, is governed by a *law of third order* (a law of structure): the *law of the sequence of mental states.*

The top layer – the *field of third order* – is that of **mental states**. They obey a law of structure: *the law of the sequence of mental states,* which is also their *interaction law.* [16]

In this scenario, however, there is one point that needs to be supplemented. I'll be right back on it. Let us first assume that all statements are true.

Now we add to these statements another statement – the one derived in section 2.2. It reads:

Of the two assertions

1. Free will exists *2. The Completeness Axiom of Science A_N is correct*

at most one is true.

[16] It may be surprising that the layer of neuronal areas of different functionality is missing, which also interact with each other according to specific laws. The inclusion of this layer as a further field of order, however, would change nothing fundamental, but merely complicate the argument. Therefore, this layer appears here only in the form of the condition that in mental states associative arrays must be active.

As a reminder once again the completeness axiom:

Everything what happens follows from initial conditions and laws.

Let us review the just depicted scenario. Obviously, in the form as just noted, it is in fact entirely determined by initial conditions and laws, and from that would now follow – as stated in 2.2 – that the assumption, *we ourselves* would be authors of our actions and choose them according to our free will, would be as absurd as the assumption, not only gravity but also a *many-armed cosmic monkey* would guide the heavenly bodies at its discretion.

So let us examine whether any of the allegations, which the scenario contains, may be incomplete or incorrect.

Let us start with the initial conditions. Their existence is taken for granted. On the hierarchical structure, there is also no doubt.

Thus the problem must lie in the law assumptions.

Three types of laws of different orders occur: the *electromagnetic interaction*, the *neuronal input-output-law* and the *law of succession of mental states*.

The first two laws exist with certainty. Regarding their definition, there is no problem. They always apply unchanged.

Through this process of elimination, we have identified the problematic point in the scenario – it is the only remaining assumption, that is: the statement:

There is a law that governs the succession of mental states.

What is problematic about it? Can there be any doubt that mental processes follow certain rules?

Let us examine what happens when mental processes run. According to our assumptions, their course follows a law of third order.

Now we include in our consideration the known fact that *any neuronal activity alters the neuronal structure*. The active patterns are reinforced, non-active patterns are attenuated – which can be effected

through changes in the neuronal synaptic activity, but also through growth or reduction of dendrites or even formation or degradation of neurons. [17]

This means:

The mental activity acts back on itself. It alters itself by changing its neuronal code: through the activation of one single mental state, all other mental states where the neuronal areas in which they are encoded overlap with the ones of the active state, undergo an alteration. (Since each mental state is distributed over a wide range of the network, the areas of many, if not all mental states overlap each other.)

With this, also the rules of the sequences of mental states change.

For comparison: though in processes, which occur in physical systems, continually new states are produced – i.e. the values of the variables change –, still the laws remain the same, and also the structure of the state space remains unchanged, provided that external influences can be excluded.

In contrast, in the case of mental processes not only new states are produced but also *new rules* of the sequence of these states, and accordingly the structure of the state space is constantly changing. Even if external influences are excluded, the system modifies its own preconditions incessantly through feedback. And this modification – though Hebb's law is its necessary condition – must be attributed to the dominant layer of the scenario, that is: to the mental layer. It is a *mental* phenomenon.

Therefore, there are no fixed rules of third order.

Still, another question must be clarified: Are there perhaps constant *meta-rules*, i.e. rules about the changing of the rules of the activity of the mind?

The existence of *universally valid* meta-rules would presuppose a universally valid relation between the information-content of mental states and its neuronal encoding. But such a relation does not exist. This means: if meta-rules exist, then they are related to the specific system, and from this follows, that they are also subjected to alterations by feedback.

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[17] This insight traces back to Donald Hebb, who noted in 1949 in "The Organization oh Behavior": *When an axon of cell A is near enough to excite B and repeatedly or persistently takes part in firing it, some growth process or metabolic change takes place in one or both cells such that A's efficiency, as one of the cells firing B, is increased.*

Therefore, there are also no fixed meta-rules.

We have thus deduced the following statement:

The formal representations of mental processes cannot be derived from any given system of initial conditions and equations. If such equations or rules for these representations and their transitions exist, then they are continually altered by feedback-processes.

Since the encoding of mental states takes place on the neuronal layer, and since the elements of these layer are in turn composed of physical elements, from this statement follows, as announced in 2.2, also the statement:

The physical states and sequences of states, through which mental processes are represented in neuronal networks, are not derivable from any given system of equations and initial conditions and cannot be regarded as a solution of such a system for any given time.

Thus the Completeness Axiom of Science is wrong.

Precisely because mental processes are natural processes, the following applies:

Any formal description of nature by a given system of initial conditions and laws is incomplete.

If the Completeness Axiom is wrong, then freedom of will *can* exist. Does it exist?

The answer is *yes,* and this answer consists of three statements that have been derived previously:

1. Volitional decisions are mental processes. As such, they are not derivable from physical circumstances, and this does not apply due to technical reasons but due to principle – or say: metaphysical reasons.

2. Volitional decisions act *causally* upon material circumstances.

3. Though mental processes obey their own rules, it is still impossible to derive any volitional decision from these rules: it cannot follow from them, because they can be changed by the mental process that precedes the decision. While this process runs, the laws which it obeys can change – or more precisely: *the process itself* can change the laws that applied before it started.

In summary: volitional decisions are causes of actions, and they are not predetermined.

So they are free.

3.4. Organized States in Neuronal Networks

In the last section, mental states were called *organized states of a neuronal network,* by which the dynamics of the network is governed. This can be understood as *causality top-down.*

This issue is to be concretized.

I am going to use models that are simplified and idealized to such a degree that they hardly deserve the label "model".

The justification of this method is that it permits to explain fundamental properties of neuronal networks in a particularly simple and abstract way and to demonstrate how these properties are linked to mathematical principles and how they can rise to intellectual performances.

Imagine a natural (biological) neuronal network of, say: some ten thousands of neurons, which has no specific functionality and is therefore, in this sense, unstructured.

At first it is isolated, i.e. without any connection to the outside. Its electrical activity is weak, and it is random, which means that the trajectory in the (physical) state space of the network exhibits no discernible patterns.

We connect the network with the external world through a sensory organ or an input device, which converts optical signals into neuronal activity. The state of the network now depends on this optical input.

Now we present an *object* to the input device over a certain time period. We assume that, due to this specific input, a pattern is generated that persists (or is repeated) as long as the object remains in place.

Now follows the point that is crucial for the structuring of the dynamics of the network:

Due to Hebb's law, the neuronal connections, which form the currently active pattern, are ***reinforced****.*

Mathematically, this means that *the active pattern turns into an* ***attractor****.*

With this, the state space of the network has changed. It is no longer unstructured, but has an attractor that represents an object.[18]

The attractor has a *basin of attraction.* So there is now a part of the state space within which the trajectories are not random but approach the attractor.

From this concept directly follow some fundamental statements, which apply not only to our simple network model, but generally to neuronal networks where an area exists whose dynamics is not predetermined (genetically) from the very beginning but develops – as just described – in the course of time through the formation of attractors:

1. The concept "attractor" meets exactly the conditions that have been postulated with respect to mental states, i.e. that they are *organized states,* which are *structuring the state space of the neuronal network* and in this way *determine the dynamics of the network*.

If mental states are understood as such attractors, they are indeed comparable (in this respect) to the oscillation states of a membrane, which also represent attractors of the state space of the membrane.

Further conclusions can be drawn:

2. It holds that: *perception = recognition*.

The reason for that is that the basin of the attractor provides a definition of *similarity:* any new input, which causes a neuronal state that lies in the basin of attraction, is *sufficiently similar* to the original input – i.e. the object by which the attractor has been generated – that this new input can be identified *as the same object.* Due to the fact that the point lies in the basin of attraction, the trajectory will first approach the attractor and then move along the attractor, which means: the original pattern, which represents the object, is formed once again.

This means: in the case of a sufficiently similar input, not just a *similar,* but indeed *the same* pattern emerges. And because no object can, if it reappears, provide an identical input as at its first appearance

[18] That a neuronal excitation pattern, which is active for a sufficiently long time period, will be an attractor is not a hypothesis but a fact: it is simply the mathematical expression of the proven neuronal fact that an active pattern is reinforced.

– some variables will change with certainty –, the attractor-concept is necessary for understanding the recognition of objects. [19]

In artificial neuronal networks, which for example serve for face recognition, such a convergence of patterns is superfluous: here the output need not have a specific value, it is sufficient that it lies in an interval. However this "rasterization" of the output field is defined from outside – by the programmer; In biological networks, there is no rasterization, and therefore, for any kind of recognition, a convergence of various input-caused states to one single pattern is required, which subsequently can serve as output for further processes.

Of course, in natural neuronal networks also attribute analysis takes place. Yet again: no attribute produces a completely identical input on several occasions, and therefore it is again necessary to recognize that which is only similar as the same; And accordingly, the assumption is required that not only the object as a whole but also its attributes are represented by attractors.

3. The attractor concept also casts light on the philosophical question of the status of universals. As follows:

As just illustrated, objects are represented by attractors. If now the same principle is applied to the representations themselves – by assuming that these representations themselves are in turn *internally* represented (in the neuronal network) by attractors –, then the level of *concepts* is reached.

If a concept is understood as neuronal attractor, then again similarity will be defined by the basin of attraction, and all object-representations that are in this way similar to each other, will be assigned to the same concept.

From this follows:

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[19] Unless one assumes that the current pattern is somehow *compared* with already existing patterns. But how should such a comparison take place? This would require, that not only the current pattern but additionally a number of already existing, known patterns needs to be activated, such that the comparison can be performed. This is unlikely, and moreover it is still unclear how this comparison could actually be carried out.

In contrast, the explanation of recognition by the attractor concept seems simple and logical: an object is recognized, even if the input is changed in some variables, because yet again the same attractor, i.e. the same neuronal pattern, is formed. It is then immediately evident, how to an input, which – even if it occurs as the result of the same object – can never be identical, always the same object is assigned. (This pattern formation, however, must take place in the visual memory and not – as could be concluded from our too simplistic model – in the field of view itself)

Universals are constructs that result from the regularities of neuronal representation.

If objects and attributes of objects are indeed represented in the neuronal network by attractors, then we are not at all able to perceive individuals (i.e. single objects) *as such.* We recognize not the Individual, but only the General. We are just deceived by the fact that, in most cases, only one single object of our everyday environment lies in the basin of attraction of a specific attractor. However the example of twins shows immediately that this is not always true.

The same applies to thought: just as we can only *perceive* the General, we can only *think* the General.

It we *mean* something individual, then what is meant appears as individual either because of its localization in space and time, or because it is the only object that meets all general requirements by which it is defined, in other words: it lies as a whole and in regard to all relevant attributes within the basins of the respective attractors.

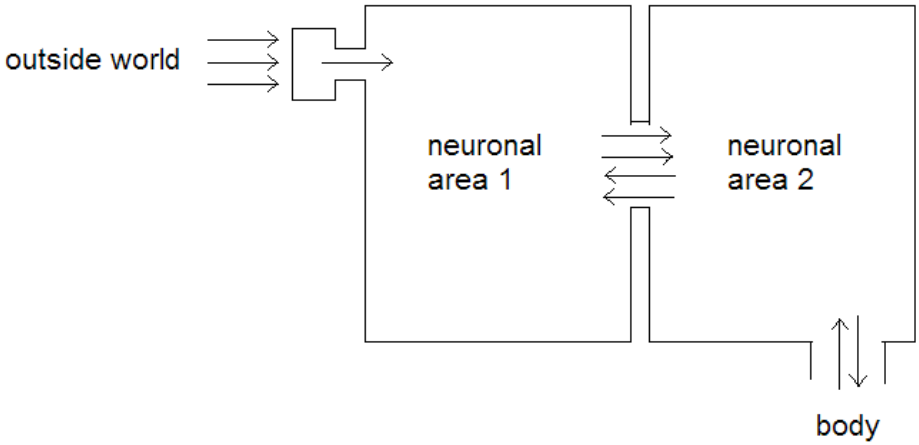
Let us return to our initial neuronal network. Let us assume that the optical input will now no longer be generated by a single object, but by a series of consecutive objects.

Each of these objects corresponds to a neuronal pattern. The set of objects is thus represented by a series of attractors.

If these objects serve repeatedly in the same order as input for the network, then also the transitions between the respective neuronal patterns – more precisely: the neuronal connections that mediate this transitions – are reinforced

Formulated mathematically: the trajectories in the state space, which lead from one attractor to the respective next one, turn into *attracting trajectories,* in the sense that trajectories which are sufficiently close will approach them. This means: The state space of the network is now not only structured by attractors, but also by trajectories that lead from one attractor to another – in other words: the object-representations are linked associatively.

We now extend the model in the following way: In addition to the first area, which is connected with the outside world, a further neuronal area exists that receives an input which represents the *body information*. Though the two neuronal areas are connected together, they work largely independently.



What has changed thereby?

Now the state of the network depends not only on *information from outside,* but also on *body information.* It consists of two attractors, which are connected by neurons with each other and permanently exchange information, so that the variables by which an attractor is defined depend also on the other attractor. In this way, inside and outside information is connected. Also the state of the whole network can be understood as attractor.

At this point, an important feature of attractors comes into play: even if the initial conditions are only partially realized, the neuronal patterns, to which they correspond, will still emerge. A subset of the variable values that belong to a point in the basin of attraction represents a sufficient precondition for the formation of the attractor.

In our context, this means the following:

If an object (or a situation) and a body condition occur several times in common, then – as a result of the neuronal connection between the two areas – later the pattern that develops in one of two areas alone is already sufficient to induce the according attractor in the other area. Thus the attractor that represents the object information induces the attractor that represents the body information and vice versa.

If one assumes that not only the body controls the network, but also the network the body – which in the drawing is indicated by the arrow leading down – then the object affects the body condition:

Initially, that attractor is formed that represents the object; this attractor induces the one in the other area, and that one generates the associated body condition.

Through these relations, objects (and situations) are associated with body conditions. The body information thus represents an *evaluation* of the objects: depending on the type of excitation of the body, the objects are assessed positively or negatively. Moreover, the extent of the reinforcement of the active patterns depends on the degree of excitation.

Now the following must be considered:

The neuronal patterns that represent objects are attractors in the state space of the network, and the associative connections between the object representations are attracting trajectories in this state space. Therefore, they are structures that exist *in the network itself*, and this means that – even if no input is present – the dynamics of the network is determined by these structures.

Thus the network generates – by itself and independent from any input – sequences of representations which are connected with body information.

This can be seen as basis of *intentionality.*

With this, the possibilities of our simplified model are largely exhausted. After all, they were sufficient to justify the concepts of the previous section, where they have been presented in a completely abstract way, and to lead them a bit closer to reality.

Through its ability to generate a specific pattern also from altered or even fragmentary initial conditions, the attractor concept permits to understand how mental states, such as representations or ideas, are strung together to associative sequences. Indeed, "associative linked" means nothing else than "connected by a trajectory in state space, which has been run through repeatedly and is therefore reinforced".

I want to finish this brief excursion into the regularities of neuronal networks with some general remarks about the status of scientific descriptions of features of neuronal networks.

On the one hand it is clear that, due to the complexity of human neuronal networks, it is not possible to analyze mental phenomena mathematically or replicate them artificially. The complexity is so high that it is neither theoretically nor technically manageable.[20]

[20] In chapter *5.Qualia* will be shown that the simulation of the mind is impossible for *principle* reasons.

On the other hand, it is simple and largely unproblematic, to obtain a basic understanding of how mental features and performances can be brought forth by neuronal networks.

An example: We understand – though not in every detail – how objects of reality are perceived visually. We know the physical processes through which the information reaches the retina and from there via the visual path the primary visual cortex, we know how the entire object information is broken down into various components – color, texture, characteristics, contrast, shape, motion, orientation, depth –, which are first processed separately and then brought together again. This knowledge gives us a basic understanding of how information is encoded in neuronal networks and how this encoding allows object representation.

Another example: awareness. It is possible to understand awareness in a simple and consistent manner by assuming that it is a meta-representation, i.e. a mental state, which is characterized in that the information content of states of the neuronal network itself is in turn represented and further processed in another area of the network.

From the assumption that the information content of perception states is a representation of cutouts of reality, it is not a big step to the assumption that, in neuronal networks of sufficient complexity, also the information content of *inner states* can be represented in the same manner. The possibility of such a meta-representation requires only the existence of another, hierarchically higher level of information processing.

Generally, it can be argued that the understanding of mental phenomena, which is based on the assumption that neuronal networks are information-processing systems, does not lead to any fundamental scientific or philosophical problems – provided that this assertion relates only to the *information content* of mental states and not to their *feeling content*. (Why mental states are *qualia* will be answered in the 5th chapter.)

Note:

I emphasize again that the models presented in this section are unrealistic simplifications. Nevertheless, they serve their purpose: to show, how the structure of the state space of a neuronal network develops and how the neuronal processes are determined by this (at least short-time constant) structure; – and this is the core of the argument that here causality acts top-down, that is: from mind to matter.

3.5. Summary

Since the conclusions that have led to freedom of will, will once again be presented in the next chapter in more general terms, I can be brief here.

What is the reason that a middle c is heard, if I strike the tea cup, standing in front of me, with a spoon? What is the cause of the character of this tone?

Not the fact that the cup consists of particles, nor that the particles interact electromagnetically. No, the reason for the height and character of the tone is the *form* of the cup.

From the interaction law follows only the speed of propagation of the initial disturbance. Together with the form of the cup, it determines the pitch. The character of the tone – the specific overtone structure, i.e. the *oscillation pattern* – is entirely dependent on the shape of the cup.

Already this simple example demonstrates that, in systems whose dynamics is determined by boundary conditions, in addition to the specific laws of nature, laws of form occur. These laws are dominant. The global state of the system is the *cause* of the local events; thus, causality does not act bottom-up but top-down.

Analogously can be understood that mind is the cause for the dynamics of human neuronal networks and therefore also the cause of human behavior and the according physical changes.

Mental states are organized states (patterns, attractors) of human (and of some animal) neuronal networks. As such, they determine the dynamics of the network. But while the cup has a trivial dynamics – it has only one single (oscillation) state – in the neuronal network there is a tremendous number of possible mental states and transitions between them.

These states are not derivable from the neuronal input-output law (as the state of the cup is not derivable from the electromagnetic law), and the same applies to their transitions.

This means: mental states are related to each other *as such.*

Therefore, the area of reality that we call "mind", is a self-dependent layer of reality, which must be attributed its own dynamics. The laws of this layer are dominant. What happens in the network is therefore caused by the mind and not by neurons and the neuronal interaction law or by the functional architecture of the network.

To learn what is going on in the network, one has to refer to the respective mental activity and its individual rules. Among these rules are, for example, *reasons*.

Thus, asking someone for his/her reasons to find out what he/she will do is as justified as determining the point where one billiard ball hits another one in order to predict where the ball will move, or as determining the form of the cup in order to calculate its sound.

Generally speaking: *for the knowledge of the dynamics of a system, the dominant laws of the system must be known. In the case of human neuronal networks, these are the (subject-specific, variable) laws of the mental activity, which belong to the respective network.*

At this point of our train of thoughts, the phenomenon *mind* is completely reestablished, in other words: mind is resurrected as the phenomenon as which it is given to us intuitively.

To obtain this result, it was particularly important that we have liberated ourselves from the common confusion of *neuronal activity* and *mental activity.*

In order to get to the justification of freedom, an additional step is required.

Prerequisite is the statement: The laws of mental activity determine the dynamics of the network.

If these laws were *fixed* – like physical or neuronal laws – then freedom would not exist. But this is not the case, because the mental activity *acts back on itself.*

The physiological precondition of this feedback is Hebb's law: adjacent neurons, which are activated simultaneously, change in such a way that their mutual stimulation is reinforced. Conversely, unused connections are reduced. Thus, the mental activity changes its own preconditions. It acts back on its neuronal encoding, and, with this, changes its own laws.

Therefore, in the system of mental states, not only new states are generated – as is the case in physical systems – but also new laws. The system enters a feedback loop. The rules to which the mental activity is subjected are changed by this very activity.

So there are no fixed rules which determine what will happen.

This means: Volitional decisions do not follow from any system of initial conditions and laws.

If nature is seen as such a system, then, in this system, volitional decisions that will happen in the future – as well as all other future mental processes – are *undecidable statements*. They cannot be derived in the system, and the same applies to *any* such system.

Thus there is room for freedom.

To arrive at a final judgment on free will, we define volitional decision:

A volitional decision is a mental process, where

1. the consequences of alternative actions are evaluated and

2. the alternative is chosen, which is judged as the better.

The following statements have been deduced:

A1: Mental states cannot be derived from physical or neuronal laws and initial conditions. They are networked with each other and form an autonomous layer of reality that has its own laws which, however – in contrast to physical laws – are not fixed. Among these laws are e.g. reasons.

A2: Causality acts top-down. Mental processes cause neuronal processes.

A3: The information, which is contained within an arbitrary temporal section through a human neuronal network, cannot be transferred to a system of initial conditions and rules. Future mental processes are not contained in such a system. The future is open.

The statements A1, A2 and A3 suffice to substantiate freedom of will in the usual sense.

Moreover, they define what freedom in the metaphysical sense means, that is to say: freedom in a nature that unfolds in accordance with laws.

Notes

The difference between *mental* and *neuronal* processes

Obviously, there are also processes in neuronal networks, which are not determined by the mind, that is: not by the network of the relationships between the mental states themselves, but by the functional architecture of the neuronal network, by the neuronal input-output law and by external circumstances. In simple neuronal networks, *only* such processes take place.

The occurrence of mental states – and with it the dominance of the mental over the neuronal – is only possible, if the neuronal network contains areas, which are *functionally unbound.*

Only areas of this kind, in which therefore – as was also postulated for the simple model network at the beginning of this section – the neuronal activity is not determined by physiological functions but is at first random, are open for the structuring by those organized states (attractors) that represent outer (real) or inner (bodily) circumstances.

However states, which represent something, are not yet mental states. Mental states must also *relate to each other.* Only through this internal network of relationships they become what they are.

Therefore, representational states can only turn into mind when they network with each other. Evidently, the existence of functionally unbound neuronal structures is a necessary condition for that.

The assumption that mind can only appear in living creatures who have sufficiently developed areas of this kind, is also supported by experience with animals. Their intellectual performance depends on the size of the cerebrum, and only in the cerebrum there are such areas. [21]

The difference between mental and neuronal processes can also be characterized in the following way:

Neuronal processes can – at least to a large extent – be observed, measured and predicted.

[21] The term "cerebrum", however, must not be tied to the physiological structure, which in humans occurs under this name. In birds, this structure is poorly developed, so that their intelligence has been underestimated for long. Instead, they seem to have enhanced the basal ganglia, and the remarkable intelligence of some bird species despite their small brain size suggests (and gives hope) that *this* neuronal tissue – or this kind of "cerebrum" – is more appropriate for thinking than the human one.

In the case of mental processes, this is only possible to a very small degree.

And if the mental processes are *thought trains,* then there is only one method to learn something about them, that is: to ask the one who thinks for his/her thoughts.

The extent of mental activity

Mental states are not present in neuronal networks from the beginning. They need to develop.

To a certain extent, this development probably follows from the properties of the neuronal system.

However what goes beyond this minimum depends on whether education and cultural conditions favor the development of mental activities.

The same applies to the freedom of the will. It exists only when the consequences of alternative courses of action can be judged, and this ability presupposes knowledge and discernment.

Whatever one's position is on the current concentration on the material (genetic, neuronal, chemical, etc.) preconditions of the personality and of thinking – it will in any case contribute to reducing the independence of mind. Mind exists only in the degree to which it is understood as an autonomous reality and practiced as such.

With phenomena such as free will or responsibility, it is the same as with other mental features, e.g. language: if they are not acquired – and there are often critical phases, after the end of which the respective ability can develop only incompletely – then they exist just rudimentarily or even not at all.

Closing

As it turned out, philosophers arguing

- that in the mental area reasons apply and not causes
- that scientists equating mental and neuronal processes and therefore producing grotesque statements like "the brain decides that …" are trapped in a categorical failure
- that free will as subjective certainty can never be abolished by scientific argument

have been perfectly right. However, against the raw onslaught of natural science, their true and beautiful assertions oppose just as little as the chant of the druids against the attack of the roman legions. It is simply a fact that hitherto there has not been any possibility to unite those two kinds of phenomena that seem so self-evident to us – the objective and the mental ones – in a single conception of nature.

For centuries the difference between them has appeared as an insurmountable discrepancy.

The historical attempts to solve the contradiction are no longer viable. Descartes' dualism – as well as all other metaphysical or religious dualisms – would simply be absurd, and understanding the contradiction as Kant did – as unsolvable antinomy –, is not acceptable in light of the enormously grown knowledge about nature that urges us to understand nature as a unity.

The consequences are reductionisms and functionalisms based on scientific modeling.

The scientific paradigm is indeed not only enormously successful, but also appears to be of convincing completeness: nothing escapes the laws of nature.

The ideas of mind, ego and free will are in danger to choke on this stranglehold. If even their inner certainty and self-evidence cannot protect them against the infringements of natural science, then any philosophical arguments will not succeed either.

No – if there are any limits for the scientific paradigm, then they must become clear out of it itself.

That is exactly what we achieved. The Physical and the Mental can be understood in a single model based on scientific and formal arguments, and, moreover, not in the form of functionalism or

reductionism but according to our experience, where mental phenomena are given as self-dependent and different from objective phenomena, but nonetheless both in a complex interdependency.

With this, science has lost its claim to be all-comprehensive. We have demonstrated that formal description is not applicable to mental phenomena.

Continue to the next chapter 4. The modified Picture of Reality.

Continue to chapter 5. Qualia.