BEYOND MATERIALISM!

From artificial intelligence to the culture wars

Martin Korth

Beyond materialism!

From artificial intelligence to the culture wars

Martin Korth

v1 (7.4.21), now v7 (4.4.22)

cover: theory of everything envisioned by a schizophrenic (my dad)

dedicated to my sister Regina

Contents

Chapter 1

All things counter, original, spare, strange

This book is basically one wild ride through topics as diverse as artificial intelligence, modern physics and biology, up to social injustice, sustainability, and the culture wars. The underlying theme is that the world is probably much more colorful and kinder than we usually tell ourselves.

It claims that the next big step within the human venture of understanding the world will be an extension of our scientific theories to the non-material part of reality that we commonly associate with the mental processes of our brains. Currently, our scientific belief is that such mental phenomena are the outcome of underlying material processes, and we thus concede the non-material world only a derivative existence.

For our purpose here I will call this world-view materialism, i.e. the underlying conception that the 'real' world is material, while the non-material is of 'derivative' nature. Throughout history, some of our greatest thinkers held very different views, from Plato's theory of ideas, over Leibniz's Monadology up to Gödel's take on mathematics - and many Philosophers today are quite sure that they still have a point.

I will try to show that also from the scientific side, the discussion should be far from over, though taking the next step will clearly be a moonshot project, given that any unifying theory will have to take proper care of both the philosophical arguments for the non-material, as well as todays highly sophisticated scientific theories.

Why should we nevertheless attempt to develop it? I believe that although we are not in desperate need of such a theory, it would help us tremendously to grow beyond the current 'materialist deadlock' in which our ignorance and arrogance towards the non-material actually limits our ability to properly understand and handle our lives, and thus fails to help us in tackling individual tragedy, social injustice and the destruction of our planet.

Current science delivers us facts on climate change, social inequality, and mental health, but it has lost the emancipatory power of the enlightenment to forcefully argue that we should strive for a greater good. Understanding material consistency requirements, expressed in our laws of nature, was a major achievement of science, helping to free people from superstition, tyrants, as well as material hardship. Acknowledging the limits of consistency in the non-material, and understanding the 'mechanics' at the material/non-material interface could give back the trust to rational thought that is necessary to re-enlight science and society.

So what's holding us back? Basically, our past successes. Philosophy has largely retreated behind science's impact on the material world, although it can rather clearly formulate the problems with even our best physical theories. And science itself has become a victim of this very success in that it has opened up so many more interesting and important questions about the material world that it has become far too busy to again revise it's core beliefs. Apart from a few fields like research into human and artificial intelligence, or mental health, there is simply very little need to not just steadily grind through the vast amount of possible work.

Focusing on the in my opinion most important problems for our current scientific world-view, namely qualia and mental causation, I will try to map out how we could think about a scientific theory for both the material and non-material world. It should be clear that to wish for a more meaningful world is not a new impulse, and that many have come up with beliefs about 'higher level' forces in our world. These beliefs are often driven by strong, but hard to generalize religious convictions, and they usually avoid the core problem we have to address, which is to make sense also of the deep insights and great powers of science in such a framework.

At the heart of this book is therefore a simple model of a unified theory which lends itself to a set of scientific questions to evaluate this model. There is no doubt that the suggested model is wrong in many ways, but I think the features and failures of the model nicely illustrate the questions we have to face, when attempting to create a theory for not only the material, but also the non-material world. To make the value of such a unified theory more clear, I will begin with looking at human vs artificial intelligence, and in the end return to the impact of tackling the non-material on mental health and our social lives.

The world probably IS much more colorful and kinder than we usually tell ourselves. To life up to this world we will have to grow; intellectually, personally, and as societies.

Chapter 2

Artificial intelligence – Thinking exceptionally hard?

After computing machines have surpassed human abilities in performing logical operations long ago, the last two decades have seen computers conquer also the proposed audio-visual layer between us and the world, with machine learning based object detection and natural language processing.

The power to talk or write and maneuver in a world of objects opens up our social and economic world for these devices. The success of 'Artificial Intelligence' (AI) will not depend on machines becoming as intelligent as humans, but will come with machines being able to take over or at least help with rather 'normal' human tasks. Future applications in autonomous systems and especially robotics are likely to have deep economical, political and social impact, wherever enough data can be mined and human skill sets can be replaced or outdone.

Research into AI will most likely also play an important part for understanding the neurological workings of the human brain, which in turn could enable even more powerful technologies, but it is nevertheless clear that the current wave of AI approaches is still rather far from understanding human intelligence.

One way of conceptualizing this is to understand that current AI is working on the basis of fitting correlations, without understanding the underlying causal relations. This is why current AI models can so easily be fooled, for example with very minor alterations in pictures of objects to be recognized.

'Causal interference' promises to go beyond this limitation, by teaching computers to 'think' within the framework of causes and effects, but it needs to be build on a 'meaningful' causal analysis of the situation at hand, which itself is in general not accessible to computing machines, because causal effects - unlike data correlations - can not be observed directly.

This 'fundamental problem of causal inference' seems to me closely related to David Hume's and Nelson Goodman's thoughts on the method of induction: The standard AI procedure of making predictions based on data correlations is like inducing a hypothesis or proposed rule by abstraction from experimental observation.

David Hume famously questioned the general validity of such inductions as being mere habits of the human psyche. Causal interference now wants to 'stabilize' the machine's reasoning, by picking out certain rules as the most helpful ones.

And this is where Nelson Goodman comes into play: He pointed out that induction ('bottom-up logic') actually has the same standing as deduction ('top-down logic') in that we have no logical, but only pragmatic – still rational! – arguments for their use. (This doesn't sound intuitive at first, but think about it; what logical arguments could we provide to prove that a certain logic applies?)

So induction is actually fine, but a 'new' riddle emerges: How do we manage to pick good rules to check for their validity? For some reason, humans can do this, but machines can't; and that's why causal interference will have a hard time without at least a good chunk of human-driven causal analysis.

And I would go even further: How is it at all possible to form a hypothesis purely from data? A hypothesis structures data as chunks of meaning - but where does this 'super-structure' come from? In 'unsupervised' machine learning, we often 'cluster' data into categories, but while this allows for a mathematical structure from 'pure' data, it seems far from (and useless without) the human reasoning behind. I believe that this difference between data or information on one hand and meaning on the other is at the heart of the human vs artificial intelligence problem. (The Chinese room argument by John Searle makes the point in a more stringent way. In Philosophy of Information people investigate the related sign grounding problem.)

Both correlation and causal interference operate on information, while human intelligence seems to operate on chunks of 'meaning', thereby easily (often too easily) 'seeing' causal relations basically everywhere. The actual problem seems to be that AI can not cross this gap from materially implemented information to mental chunks of meaning.

Large parts of current research into AI and also neuroscience are based on the assumption that the perceived gap (also called Leibniz's gap) is just a symptom of our limited knowledge about the human brain, and therefore nothing to worry about. And this may well be, but here I would like to investigate the hypothesis, that it is actually the key to understand AI and the human brain. So what is the gap? And what are the core scientific problems to bridge it? I will try to answer these questions over the turn of the next chapters, but let's stay a little bit longer with information and meaning for now.

Is human intelligence really so special? Think about the following counter argument: Once we have reasonable rules, the 'machine learning' statistical part of adjusting and applying them is comparably clear - and the last decades have seen an explosion of work on the neurobiological implementation of such algorithms. And to go one step back, once we have rules at all available, repeated application of something like causal inference would allow us to pick reasonable rules for further evaluation. So if we just need rules at all, do we really have to be able to generate them from nothing? Maybe we can just pick elements for rule-building from a long list? Our language certainly is such a list, and it seems quite fitting that it (at least in the beginning) grows in line with the development of intelligence in humans. Additionally, this list would not have to be given in a static way, but could be acquired like through current language processing algorithms.

With such a long list of 'meaningful bits' the application of a set of consistency relations, and a gigantic amount of computation time, it doesn't seem so impossible for a machine to explore causal relations similar to a human being, only that people don't seem to do this with 'brute-force' computation; for bio-economical reasons, the brain is rather laid-back. The current trend to cross-link language and object models is already a step in this direction of making the world 'understandable' to machines. So Geoffrey Hinton is most likely not wrong, when claiming that AI will be able to do everything a human can do. But it still seems that humans will always be able to step back, form a completely new rule, get one level higher in their reasoning and all of this with a rather modest amount of computing power. (The Gödelian Argument by Roger Penrose puts this belief on a more proper, logical foundation.)

Maybe it is our senses, which supply us with more material to form (and break) rules? We certainly base our world on our senses and learning by exploration of this world. The equivalents for machines are streams of information and 'reinforcement learning', i.e. learning by feedback from the environment. Machines can't find a short-cut in this, but we seem to be able not only to walk, but to also jump through the data stream. Machines process information and are subject to physical causation, but we have in addition sensory experiences, or 'qualia', which go beyond pure information (see next chapter for details), and seem to influence our environment also by mental causation. Machines have to be supplied with a framework for interpreting data, because there does not seem to be an underlying universal framework, which does not fall prey to scepticism (unless we resort to something like the language example above for purely pragmatic reasons). Humans seem to work despite scepticism by taking qualia as granted, i.e. by relying on inherently meaningful chunks instead of pure information.

Thinking allows humans to short-cut computations, in so far as navigating the non-material from meaningful chunk to meaningful chunk seems to work like a quantum computer for us. Such a computer solves (for now rather theoretically) extremely huge computational tasks, by first 'entangling' all possible input states, compute (or evolve) simultaneously all possible solutions for the states and then dis-entangle the states in the end to get the final result. The meaningful chunks we are thinking with seem to work a lot like entangled information bits, so that moving from meaning to meaning allows us to 'compute' huge amounts of information simultaneously. But is our brain a quantum computer? Most certainly not. The physics is simply not in there, also we never entangle oder dis-entangle the bits. Rather than our brain being a quantum computer, I think what we see here is, that thinking works quite different than physical computation. We will later on return to this question in more detail.

The essential point I would like to continue with is, that the gap between human and artificial intelligence is not a quantitative, but a qualitative one. Human intelligence relies on sensory experience and chunks of meaning, both beyond pure information - and this means that if our scientific world-view cannot account for these, there is little hope to understand human intelligence within this world-view.

But how could science make sense of and accommodate qualia, and maybe even mental causation and scepticism, two other essential features of the human condition which don't fit well? Philosophy has a long history of investigating these issues, and we will turn to some results of this journey in the next chapter.

Chapter 3

Philosophy – Let them speculate in their cold empty ice-heaven!

A very unfortunate habit of the natural sciences is to ask for rigorous thinking whenever mathematics is involved and where this wish can rather easily be realized, but to accept much lower standards when talking about conceptual issues, and where things get really complicated. (I know, because I still do it myself as a scientist.)

It is this habit I believe which allows natural scientists to get away with oversimplified philosophical views of their field, and as a result to easily dismiss the – in fact often more rigorous discussion – in modern academic philosophy.

But is philosophy not just a great mess - at least from the scientific point of view? I think there is little excuse for thinking low of the achievements of philosophy, only because she 'progresses' mainly through her grand failures (as in fact everyone does too). Philosophy has the enviable humility to deny progress by cherishing thinkers not for their great theories, but for coming up with even greater open questions. And philosophical 'progress by failure' was always at the forefront of also scientific thinking.

Descartes failure to base all knowledge on his *cogito ergo sum* lives on in the methodological thinking of such titans of the natural sciences like the natural philosopher (or 'last of the magicians') Isaac Newton, the great Leibniz or (especially through Ernst Mach) also Albert Einstein.

The later failure of Bertrand Russell to supply a theory of the logical structure of the world lived on first in the efforts of David Hilbert to identify such a theory for at least mathematics, and then in the finding of Kurt Gödel that also this endeavor is futile. But far from being fruitless failures, they motivated not only American Analytical Philosophy in the footsteps of Willard Van Orman Quine but also Alan Turing and John von Neumann to find out what actually can be computed about the world, thereby leading in turn to the information revolution.

A modified view of human vs artificial intelligence, might thus also be later understood as the start of a second ’secularization’ of logical analysis, the first one leading to ’perfect’ (though limited) computing machines, the second one leading to ’perfect’ (though not human-level) machine thinking. If for instance we find that human-like intelligence is bound to some form of life, we might be freed to concentrate on what nevertheless can be done by machines.

The important message to natural scientists is, that we should not think low of philosophy, just because she was always willing to let her grown-up children go on their own – children who often viciously tried to prove their independence afterwards.

So what are the core arguments of philosophy for the non-material? Probably most prominently discussed is the ’hard problem of consciousness’, which is concerned with the nature of qualia, i.e. the qualitative nature of our sensory experiences beyond their mere informational content.

The literature is vast and the details can get very complicated, but the essence is that science can neither explain nor make much sense of qualia, because we do not know how to account for qualia starting from basic building blocks distributed in spacetime, i.e. our prevailing scientific world-view.

To understand what the problem is, let’s try to imagine ’What is it like to be a bat’ (Thomas Nagel), i.e. to experience echolocation. Surely a bat is not just processing information; echolocation must somehow have a certain ’feel’ to the bat, too. Or think about ’What Mary didn’t know’ (Frank C. Jackson), a brilliant scientist forced to work on color vision in a black-and-white laboratory – does Mary learn something new about colors when she sees them for the first time? (Not that Mr Jackson wants to free her under all circumstances; he considers giving her a color TV ...) What about a world where not the physical realization, but the subjective impression of colors are swapped (green looks like red and vice versa) or even omitted? Could we even omit all qualia and arrive at ’zombies’, identical to humans in all, but unconscious machines nevertheless, as for instance David Chalmers considers?

Another problem connected to the non-material is the problem of mental causation, i.e. whether there can be mental causes for physical effects, which can also be seen as kind of a minimum model for the question of free will.

The discussion is again quite extensive, but for us here the main point is, that there seems to be no way in allowing for mental causation in our current scientific models - although mental causation is a defining feature of the human experience.

Jaegwon Kim has forwarded a ingenious argument against mental causation, to which we will have to come back later again in more detail: He claims that the mental is causally impotent, because the 'pairing relations' for the physical world are spatial relations and no such relations exist for the mental: Spatial location gives identity to material things, thereby allowing for causal interaction. Without a spatial location and therefore identity for non-material things, how should causal interaction be defined? Other arguments consider causal closure or physical conservation, putting forward that the material world is self-sufficient, with no need or even possibility for mental causation.

A third problem, which is commonly not seen in connection with the non-material, is the challenge of scepticism. Later on it will hopefully become more clear, why I think it is actually quite strongly connected to the non-material, based on the for me most interesting questions about scepticism: Why do we encounter the problem at all? What features of our world enable scepticism? Are these features of the material- or the non-material world?

The problem of the non-material can least easily be neglected for qualia, so that we should concentrate much of our energy on this one, especially since we haven't been able to really progress on it at least since the times of Newton. Even then, John Locke had four arguments not so much against Newton's mechanics, but against the idea that it is a full description of the world. Apart from cohesion, motion and the exchange of momentum, as well as the existence of (unmediated) long-range forces like gravity, he was also already concerned with sensations: He claimed, that we are so far from knowing how material parts produce sensations, that we can by no means conceive how any material part can possibly produce sensations whatsoever, because 'there is no conceivable connexion betwixt the one and the other'.

The common 'solution' within our current scientific world-view is to acknowledge, but then ignore the problem of qualia, and because of the quite unclear and seemingly non-existent relevance for our current scientific theories, this is certainly fine for most scientific endeavors.

The thing is, that reality does not really show a blatant gap, but rather looks suspiciously 'gappy' (as Levine put it). And while we should definitely continue with our everyday scientific work, many wonder whether this gappy-ness is not actually a key to much more. For the rest of the book I will speak of the mind/matter gap, when referencing to this gappy-ness, but keep in mind that the perceived gap or gappy-ness is itself something to be explained.

To dig deeper (and maybe get more insight into human intelligence, mental health and much more) I think we have to first step back and develop at least a minimum model of a world which allows for the minimum of non-material phenomena to be objectively real, i.e. for qualia and (some form of) mental causation.

Only that the real challenge is not to come up with such a model, but to make sure it is in line with our best scientific theories - because there is little we should doubt less. So let's take a look at what these theories actually tell us.

Chapter 4

Science – To aim for simplicity and hope for truth

Science very clearly is one of the great achievements of humanity. Today, ranging from Quantum Field Theory (QFT) to General Relativity (GR) and from the standard model of particle physics to the standard model of cosmology, as well as from chemical theorizing to the biological theory of evolution, scientific thinking (not necessarily always by official scientists) has provided us with profound insights, almost magic-like capabilities of prediction, and the technologies which enabled our modern world.

So today, science presents us with an utterly condensed and useful model of reality. It is on the other hand still a derivative (basically the nitpicker version) of rational thought, which is most often just common sense, and this I believe gives our human experience of qualia and mental causation a huge argumentative weight. Additionally there is, even after decades of discussion, still no consensus on what the scientific method is (or whether there actually is one such method), although there nevertheless seems to be something like proper scientific thought.

Many scientist resort to Karl Popper's view of the scientific method that it basically consists of putting up hypotheses, which can be proven wrong, but never verified, and stick to them as long as you can. Philosophers have shown that we seldom put a single hypothesis to the test, but rather a whole system of them, and – if you remember Nelson Goodman's new riddle – Popper avoids the hard problem of what actually is an acceptable hypothesis. There are some criteria which can be applied (first of all Ockham's Razor, to not unnecessarily add complexity), but none of these criteria is completely fool-proof (why for instance should the world adhere to a principle of minimum complexity?), they are not seldom in conflict, and they hardly make up a method to come up with a new hypothesis. That's why also scientists need to be creative. So is there a core of scientific thinking?

To me this core is open, critical thinking, but not in the way in which it is often proclaimed today, i.e. critical first of all towards the work of established experts. To me it means the opposite of ignorance and arrogance, i.e. open and SELF-critical inquiry.

This means that although our scientific world view is challenged by the mind/matter gap, there is no point in bending science to cover the gap. Quite the other way around we have to take the assumed 'correctness' of current scientific theories – including of course evolution – as a starting point for your investigations.

And at all times we have to keep im mind, that the problem is not so much that these phenomena could not fit in at all, but that science can't make it convincingly plausible in which way they actually do. This could indicate a necessary modification of the underlying assumptions, but it could also mean that we're just not ready for a scientific description of qualia and mental causation.

I will in the following advance the view that the former is true and set up a challenge for our current scientific world-view in the form of a modified model and a number of scientific questions – i.e. questions which are in the reach of proper scientific investigation –, which would show whether the modified model is possible. The later chapters of this book are then basically arguments why the adoption of a new model (not necessarily the proposed one) might be advantageous.

Why do I think there is any chance to do so? Aren't our scientific models so basic, that there is simply no way around taking them as the full picture, although there is possibly some ugly appendix left? To this I would like to answer, that it is not as if we 'see' the laws of physics. What we actually experience are qualia, their change, as well as mental causation, i.e. phenomena, as well as our explanations of them – everything else is probably just (quite sophisticated) poetry, as Max Planck put it.

A unified theory should certainly not devaluate any scientific insights within their proper domain, but the goal is to recover the 'phenomenological content' of current scientific theories in full, not the 'ontological content' of the theories. So while it is a central touchstone of our venture to explain why we end up with exactly those measurements and formulas of science within our material framework, we are free to posit different basic entities or structural elements as long as this allows us to extend the theory in some helpful way. (And beware: In science, we often simply take mathematics literally, with particles as 'substantiation' of some mathematical structure, which I think can be extremely misleading. Alfred North Whitehead called this the 'fallacy of misplaced concreteness'.)

We should thus not question QFT, GR or any other of our central theories, but think about whether and how they could end up like Newtonian mechanics as a limiting case of a larger framework, in our case as the material limit of a not only material world.

I understand Plato's theory of ideas and Leibniz's Monadology to propose solutions to this underlying problem – so who are we to believe we can progress where they failed? The difference I think is that the understanding of the material world at their times was too limited to reach further; they ventured into an under-determined space. I believe that it is exactly the great sophistication of modern science which makes progress not only extremely hard, but which also delivers the clues we need. So we might be ready to make it work; we certainly haven't really tried yet.

Chapter 5

The setup – The defect common to all theories

We're getting closer to setting up a first model for a unified theory. This setup will be based on four assumptions about modifications that might be necessary to our scientific world-view:

First, a modification would extend the current model in a way, so that both scientifically well-understood (roughly: material) and scientifically less clear (non-material) phenomena would come to rest under a unifying structure, i.e. the new paradigm should be of monistic nature.

Second, a modification would take full account of the 'unclear' (non-material) phenomena without marking them as obscure, epiphenomenal, or non-existent.

Third, a modification would not devaluate any scientific insights within their proper domain, so that the 'phenomenological content' of current scientific theories would have to be recovered in full, where 'phenomenological content' means the ontology-tolerant, but theory-laden observational 'facts' of our scientific experiments, as opposed to the 'ontological content' of basic entities posited to exist, or structural elements used by our scientific theories.

Finally, the modification should illuminate why we experience a gap.

Given these assumptions, what 'unifying structure' could we think of based on our existing knowledge of the material and non-material world? I think whatever model we come up with, it would have to answer the following four questions: 1. What are the basic constituents of the model? (If only as contrasting sides of a unity.) 2. How does diversity and change occur? 3. How does the mind/matter gap arise? and 4. How to explain 'accidentals'? (By which I mean facts which are not necessarily given within a model, like for instance random initial conditions or the outcome of evolutionary or historical processes.)

Concerning question one, our current scientific world-view would suggests a universal wave function and a set of interacting quantum fields distributed in spacetime as basic building blocks, and regarding diversity and change, i.e. the second question, physics can offer a sophisticated model of a small number of basic interaction types which lead to aggregations of increasing complexity. The third question is usually omitted by current science on the basis of the feeling that the gap is either non-existent or we're just not yet ready to explain it. Turning to the fourth question about accidentals, science rests it's arguments mainly on causal development, with the standard model of cosmology in physics and evolution in biology, but indeterminism ('randomness') also plays a role in quantum theory and seemingly also at the beginning of the cosmos.

The unifying structure we are looking for would first of all have to be able to accommodate the 'problematic' but (at least to us) extremely basic phenomena of qualia and mental causation. In addition to qualia, 'real' mental causation would require acting entities, or 'agent modules', with at least the ability to perceive what to act on and then realize it's volitions, and probably also at least one guiding principle of motivation.

Such agents, once embodied, would most likely qualify as life form, but could end up being extremely simple forms of life. We will later see that what we usually call an agent would be much more than just this 'core' agent, which still needs a large network of non-material as well as material relations to act in any meaningful way. And we could even think of non-embodied agents, which would certainly not qualify as biological life, and to which our theory should better not allow more than the most basic intentional access to the material world.

The introduction of agents into our model is a bold move; I will later on argue that they are indeed necessary and even beneficial, but their function could in principle also be replaced by random events and subsequent causal development, so that it does no substantial harm to stick with them for now.

Because of the requirement to accommodate qualia and mental causation, and although we want by all means to keep the phenomenological content of science, the former two seem to be more essential to our endeavor than quantum fields and even spacetime, as spacetime does not seem to be occupied by non-material phenomena in the sense it is by material stuff. We later on have to come up with a material world of particles in spacetime, but starting with spacetime, we would not be able to get the non-material, which does not occupy a certain point in spacetime, under a unified framework.

For now, the most straightforward way to proceed would therefore be to assume that qualia and agents ARE the basic constituents and that (hopefully) everything else simply falls into place as a consequence. This ansatz leads us to 'Model A', characterized by a specific set of answers to the above-listed questions, as outlined in the following chapter.

Chapter 6

Model A – Nothing but the machine, which is everlasting

So we're ready now to propose our first model, Model A, by specifying a set of answers to our basic questions:

1. **What are the basic building blocks? Qualia and agent modules (in short: agents) are taken as the basic entities.** Two issues arise: First, taking qualia as basic, we have to be careful not to ground reality in consciousness, which would mean not to bridge the mind/matter gap, but to completely invert the mind/matter problem and arrive at some form of subjective idealism (the world as a consequence of our thoughts) with all problems attached. For Model A qualia would have to be mind-independent, objective features of reality, much like a number in mathematical realism, or also a certain physical property of a point in spacetime. In model A, *A-World* so to say, really every entity except agents would be qualia, or bundles thereof, from physical phenomena like colors and sounds to mental phenomena like feelings and thoughts. Our concept of qualia would thus be extended to qualia in the 'purely' mental realm; an agent would not have or make a thought or emotion, but perceive it like it perceives the color green. (This is actually not a new idea; it goes under the name of *Ideasthesia*. In our context we understand it rather like Johann Wolfgang von Goethe than Rudolf Steiner, i.e. no 'scientific' insights into esoteric 'truths' are made possible by this.)

This leads us directly to the second issue: If we want to set all these qualia as objective features, but some of them are not easily situated in spacetime (where does the number 1 live?), we end up with spacetime as being more likely a derivative feature of reality. This does not necessarily have to be a bad feature of our model, as there are several known open questions about the philosophical understanding of spacetime in physics. But it nevertheless *is* quite a departure not so much from the phenomenological content, but from the most common interpretations of current science – though there are of course already alternative interpretations like digital physics out there. So we just have basic building blocks at this point, no spacetime yet, which brings us directly to the second question, of how diversity and change happen, which in our current scientific understanding are closely connected to positioning (of particles) in space.

2. **How does diversity and change arise? Diversity and change happen due to the (re-)bundling of qualia by agents.** Starting from qualia as basic building blocks, it would be most straightforward to assume that diversity would be grounded in the possibility of 'bundling' (and re-bundling) qualia into new entities. These bundles would furthermore have to be differentiated from other qualia and bundles, i.e. obtain separate identities, which – in the absence of differentiation by positioning in spacetime – would mean to be bundled 'under' identifying qualia. Or maybe they could be differentiated by their relations to the agent population, with the agents somewhat 'naturally' having an identity different from the other agents. Another possibility would be that we might find the bundles differentiated only later on by their embodiment in the material world. (This issue is related to the controversy around 'thin particulars' vs bundle theories in the modern philosophical discussion of substance.) The important point for us is that we are fine already with identifying qualia (thin particular theories) as long as we accept that the non-material is plagued with several infinities - something not too surprising if we think for instance about mathematics. As part of a short excursion on Plato's theory of ideas we will take a closer look at this issue later on.

For now let's return to diversity and change in A-world: Because change processes in the physical world can be understood as consequences of initial conditions and certain consistency requirements like energy conservation, at this stage not more is needed than the (re-)bundling of qualia by agents. Later on we have to answer the question where those consistency requirements should come from, how they propagate the changes initiated by the agents throughout the material world, and we have to accommodate the indeterminism in quantum theory as well as the probably random initial conditions of the cosmological standard model.

How could we *map* diversity and change in such a (space- and time-less) world? We would have qualia and we would want them to be in some relation to each other (where indeed qualia themselves could function as relations). The simplest idea would be a graph which shows qualia as vertices and relations – maybe some dedicated qualia – as edges. Most normal entities would obviously consist of gigantic networks of relations to account for their color, smell, shape etc, but even more relations would connect most things to 'mental' qualia like thoughts about them etc. I think it becomes increasingly more clear, why the proposed bundling leads to all sorts of infinite regress problems, which really means that large parts of A-world would not behave according to classical – or actually any reasonable – logic. (If you think the whole thing now really starts to sounds suspiciously similar to Plato's theory of ideas, please wait until the before-mentioned excursion to understand the similarities and differences in more detail.)

Unlike current science, which grounds diversity and change in the possibility of (at least practically) infinite configurations of the same, few building blocks, model A would thus ground diversity and change in an infinite number of qualia and bundles thereof. Infinitely many qualia seem worrisome, but many people would agree, that we find all sorts of infinities in the non-material world and as we would accommodate not only the material, but also the non-material, it does not seem too surprising to end up with an infinite number of building blocks. (Also, many physicists are somewhat convinced that the existence of – practically infinitely – 'many worlds' is our current best model of reality.)

For agents to perceive would be to be emersed in a network of qualia, which would make up one unified view of parts of the graph, and to act would mean to reshuffle relations between the perceived qualia or bundles thereof. Now this whole model seems hardly compatible with our current scientific world-view at all, but it is exactly the mind/matter gap we want to understand, which will allow us to proceed.

3. **How does the mind/matter gap arise? The mind/matter gap arises from the enforcement of consistency requirements in the material part of the world.** The two basic facts about the mind/matter gap which we need to realize with our model are the extreme consistency of the material, but not the non-material world, and the resulting very limited (direct) influence, that the non-material world exerts on the consistency of the former. Both could be accounted for by assuming that within the material part, the change of relations and introduction of new qualia is subject to certain consistency requirements. The mind matter gap would then arise within the border region between the 'material' part, for which strict consistency requirements hold (the material world) and the – gigantically more complex – 'non-material' part for which this is not the case. Mental causation, e.g. re-bundling by agents, would be extremely easy and not bound by logic while exploring the non-material 'mental' part. It would on the other hand be basically impossible in the material part, so that quite complex interactions within the border-region would have to be amplified by mechanistic structures within the material world to allow for any significant influence of agents on the material world. Or as Friedrich Schiller put it: 'Our thoughts lie easy next

to one another, but things will jostle in the space allotted'.

From the material perspective many qualia in the non-material part would just be possibilities of being of that quality, e.g, being green, maybe even without any realization in the material-bound world. From the mental perspective, bundles of qualia in the material part would seem extremely resistant to change by mental causation. But why would the world show a gap like this? How could this accidental feature – or actually any accidental feature of A-world – be explained?

Chapter 7

Accidentals – A particular greenish whiff of the yellow

We left the last chapter with the question of how the accidental feature of the gap itself could be explained. In principle we could retreat to our current scientific standard of causal development on the basis of random initial conditions but this would extend our minimum model with the new feature of genuine randomness and at least for now it seems more straightforward to see whether we could not do without.

Also it would remain quite unclear, what would be the driving force of the causal development after the initial random setup. What mechanism would guarantee energy conservation and which one would enforce the entropic arrow of time? The current standard would be to proclaim laws of nature here, but as we find them to be at work only in the material world, this would most likely not help us to bridge the gap: We are looking for a possible reason behind accidentals in both the material and non-material world, with material consistency requirements (the laws) as an outcome in the material world, not a guiding principle for both worlds.

The last chapter probably was a bit hard to swallow for scientists, though maybe less so for those with strong Platonian, Leibnizian or Gödelian inclinations. And most importantly, it completely left open how Model A could fit to modern science! We will soon return to this most important question, but before I would like to strike a second blow, based on the considerations made above. This brings us back to question four:

4. **How are accidentals explained? All relevant accidentals in the model are to be explained by the evolution of the agent population. (Not yet 'life'!)** Within the model outlined in the last chapter, no other answer seems possible, as only the agents are free to induce change. We do of course now have to explain why we find the material world as is, e.g. guided

by conservation laws and material (as opposed to mental) causality. It is noteworthy, that once we recovered this, and in accordance with our initial considerations of keeping the phenomenological content, also the whole of biological evolution could be adopted. Only that we would have to acknowledge the possibility of non-material influences, which could nevertheless be assumed to be extremely restricted within 'lower' life forms and in the case of humans have grown up to the power of our here anyhow proposed ability to use mental causation to induce limited material change in our environments. Any direct influence on biological evolutionary processes would be prohibited already by the time scale on which life forms 'intentionally' act. (They are well able to choose a mating partner, but could not 'want' a certain genetic composition for their offspring into existence.) Biological evolution would thus indeed progress under the laws of material consistency requirements, as evolutionary biology finds it to do.

But how could this explain the occurrence of the mind/matter gap? We would have to assume that the evolution of the agent population was partly at work already before it found it's material representation as biological evolution. If for instance agents would follow a growth principle of increasing the overall number of their relations to qualia, then the evolution of some consistency requirements for possible additions to the agents' shared world would allow them to thrive on a stable basis and avoid easy destruction of their intended constructions by 'wild' changes in their 'subgraph'. Proper mental causation requires subsequent material causality, otherwise things just get weird after the first impulse.

Based on sticking to an acquired set of very simple rules, the agents would - in 'blind' search for stable growth - fortify a certain part of the world with consistency requirements into what we now experience as the material world. This would also explain the above-mentioned inability to simply 'want' things into existence: It would be exactly the extremely restricted influence of the non-material world onto the material, which would guarantee the opportunity of stable growth.

Agents would initially have evolved free from material consistency restrictions until those where adopted to anchor further development within a stable identity – and later on even the return to large parts of the non-material world by human thought. Agents would have created – rather as a side effect of their 'blind' search for stable growth – the material world, and only through this process, the material world would have allowed for life, i.e. embodied agents. (Imagine the question of how life placed itself in the middle of everything would become a paradigm of future biology: The 21st century would be the biological century indeed ...) And sharing the same material tree of life from then on, material evolution would have kept agents together in this world. It is suggestive to think that the ability to form stable, but 'growable' identities would then be the guiding design principle of our material world, and this would not only be consistent with causal determination and physical conservation laws, but would have to be seen as the explanation for their prominent position in our world. An evolving Agent population could thus also explain not only the gap, but also such 'accidentals' of the material world like material causality.

As the material world would not have been existing until the consistency requirements would have taken hold, the initial stages of this 'pre-biological evolution' would not have looked like the evolution of life forms, but like the formation of a shared cosmos. Spacetime and all physical entities would have to be understood as (actually not-so) accidental features of this formation process. 3D-space would be an embedding of our qualia/relations graph into a space suitable for efficient material evolution. Many such embeddings are theoretically possible, but the first material life forms would have 'implemented' (low-cost?) 3D-Space into our tree of life. Space would be inherently relativistic and intertwined with time, as the graph structure changes with the movement of bundles of qualia and the actions of agents in time. Time itself would play a very different role in the non-material than it does in the material world, where it would be an inter-agent counter of consequences. Agents with extended access to the non-material world like humans would be dragged along through time by their bodily part, while in their minds they would be able to experience time much less rigorous. Energy would be related to the flux of the relations between the material parts of bundles of qualia and/or agents and certain restrictions for this flux of relations would be found as energy conservation. A larger number of relations would restrict the movement more strongly, so that mass would be closely related to energy.

OK, I think you get where this is going, but the details obviously matter a lot. So at this point, let's recapitulate the core message here and try to get a fuller understanding of A-world over the next chapters, before we will hopefully be able to come back to the idea of 'pre-biological evolution' in more detail later on. (But keep in mind: We're not supposed to let it come into conflict with our well-established theory of biological evolution at any point!)

The core message is, that the accidental feature of the mind/matter gap could have developed as a result of the evolution of the agent population, which by their strive for stable growth 'implemented' the consistency requirements of our material world.

Chapter 8

Getting a hold – How to throw yourself at the ground and miss

I admit that the idea of pre-biological evolution is a bit irritating, even for the standards of this book. Whether we want to stick to it in the end is debatable, but for now it allows us to keep a very reduced model and it furthermore reconnects nicely with philosophy. Moses Mendelssohn called Immanuel Kant 'Alleszermamler', the 'All-Crushing' destroyer of metaphysics, as after his work metaphysics (investigating the fundamental nature of reality) had to take a long leave from philosophy until rather recently. He showed that before doing metaphysics we should actually first worry about epistemology (the study of knowledge): (How) can we understand anything at all?

And there indeed seems to be a barrier for understanding the world as such; that we are unable to think about the world beyond the 'categories', i.e. the very basic concepts, of our understanding. Causality would be just one example of such a very basic concept. As a corollary, also time and space would be categorial to our thinking, but – by suggesting that this meant Newtonian time and space – the turn from Metaphysics (how things really are) to Epistemology (how things are also determined by how we are able to perceive them) was – somewhat paradoxically – discredited for many physicists with the advent of relativity, which revolutionized our concepts of time and space. And although this turn is often seen as the most important move in modern philosophy, a 'Kantification' of physics never happened; physical theories describe things as such, untouched by the idea that this can not be taken for granted. I hope you see now, why I like the idea of pre-biological evolution: It is a step towards a Kantification of physics, in that it could help to explain not only why physics sees the world as it sees it, for instance structured in space, but also where our concepts of physical understanding came from, in that not even physical identity in spacetime or material causality would be a random, but implemented features of A-world.

One last comment before we can start to formulate A-world details: We have to keep in mind that we do not have to explain how qualia and agents exist in relation to particles in spacetime. This would again mean to take the material world as real and the non-material world as derivate. (Afterwards it will still be interesting for us to investigate how the non-material actually can be build in and thus – somehow *ad hoc* – fit into our material world theories.)

Some theories try to build such a non-material world on top of the material, with additional bits attached to particles or spacetime points. Once the connection between these bits become complicated enough, consciousness and all the other interesting stuff simply emerge. I believe the error with this is, that it is the defining feature of the non-material that is has no position in spacetime – this is why we have such a hard time to deal with it! Also I think, emergent features make sense if we can see a connection (like a bay can acquire several emergent features when it becomes a laguna, or when particles form an atom or molecule with emergent properties), but referring back to Locke, the point really is that in our case there does not seem to be any connection.

For A-world, the basis really is the meso-cosmic world of qualia and agents, and this world 'grounds' what we find in the micro- or macro-cosmos. So what we have to explain is for instance, why do scientist find the phenomena which lead to the formulation of quantum field theory once they zoom in on this world, and why do they find the phenomena behind the formulation of general relativity once they zoom out. Before being able to zoom in or out, we will first have to get a better picture of how A-world would actually work.

Chapter 9

A-world – Spontaneous human combustion is NOT a thing

Up to here, we only have qualia and the (re-)bundling of qualia by agents. Thinking this through in more detail one finds that the exact nature of the relations between qualia, qualia in a bundles and bundles of qualia is very complex concerning for instance such issues as nature, symmetry and transitivity of the relations. (The philosophical, logical, and mathematical challenges for a world from bundles of qualia are in fact numerous, but fortunately many issues concerning such systems have been investigated in mathematics and philosophy before.)

We could start by assuming that every quale and bundle of qualia can serve as a relation between other qualia and bundles (though some relations seem to play a more important rule for us). As we have quickly discussed before, bundling qualia could either mean to bring them together or to bring them together under one 'defining' quale, the thin particular. (Both lead to infinities of infinities, but we are fine with this for the non-material world.) In both cases their identity as a bundle of qualia is not quite clear; what does it actually mean to bring them together?

We mentioned before that Jaegwon Kim claims that the mental is causally impotent, because the 'pairing relations' for the physical world are spatial relations and no such relations exist for the mental: Spatial location gives identity to material things, thereby allowing for causal interaction. Without a spatial location and therefore identity for non-material things, how should causal interaction be defined? An identifying quale (or thin particular) could thus provide identity to a bundle in mental space, but how could this 'formal' type of individuation relate to 'real' identity by spatial location?

In A-world we can simply turn things around: It is not space that allows for identity, but it was the strive for identity that lead to the formation of space. Agents in the non-material world can relate to any quale, but this is not the build-up of a stable identity, as all activity by the agent population is one giant mash-up, and only 'formally' individuated by identifying qualia. To allow for stable growth based on stable identities, the agent population had to evolve a technique for 'abundance sharing': Only by voluntarily restricting their own access to bundles of qualia they allow the others (and in turn the others allow them) the opportunity for individual growth.

And that's what identity by spatial location is for, that's what the material world is about: Pre-biological evolution 'stumbled over' a mechanism, which proved so valuable, that it became the foundation of the material world. The first part of this mechanism is having something like 'is not' and 'is part of' relations, which distinguishes bundles of qualia from each other. The second part of this mechanism is for all (relevant) agents to adhere to these relations, i.e to not make 'is part of' relations, which conflict with existing 'is not' relations.

But our physical world is not statically defined as things sitting forever on their place in space, so the task is more complicated: How to keep global consistency upon change?

This is where regular, 'well-behaved' space comes in; if agents only modify relations in reach of the next 'is not' relations, this locality of 'next-relations' would allow to keep consistency. Looking only at these next-relations, we could get a topographical (though not yet metrical) picture of space. And what about the infinity of bundles and qualia without next-relations? After the very birth of A-world, it would be almost impossible to bring them into the material world; they would remain to be non-material, though not necessarily completely without material influence.

So material consistency is first of all realized via a space-like order (not yet space!). But what about causality? Mental causation is implemented by design, but what about material causation? The change induced by mental causation we want to allow for would have to be properly 'propagated' throughout the material world. This would not only be necessary for global consistency, but is at the very heart of meaningful mental causation, i.e. one followed up by (quasi-)deterministic change in the material world.

As the material world is only a restricted version of the non-material, we would again run into the problem that agents are the only source of change in our model: Material causality would have to be realized by a 'silent' (majority?) of non-embodied agents, which would do the tedious work of adjusting relations to keep local consistency. ('Life' would be at work literally everywhere, much like Leibniz proposed for his Monadology!) Their decisions would be free, but very limited by their 'bare' nature, void of any capability for even basic reasoning. We would see a weird indeterminism at work when we zoom in (as we indeed do!), which would nevertheless translate to reliable (quasi-deterministic) causality at the meso- and macro-scale, due to the kept material constraints on the agents decision and the law of large numbers.

Why would agents do this? Since the time of change from pre-biological to biological evolution, they would have 'inherited' a mechanism to do so from their peers which successfully managed to do so. What about rogue agents? Causality would sort them out long before they could build up any identifiable structure; they would not succeed in the material world. And only once in a while agents would get the opportunity to become embodied, that is; truly alive.

A-world thus allows for two types of change: Mental causation is easy in the non-material part, but has very limited effect on the material world. A second type of change can be found in the material world, driven by consistency requirements towards increased entropy, enforced by the 'silent' part of the agent population, and evolved from the drive towards stable growth.

Chapter 10

Recover science – For that's how it is with facts: They always end up being right

Now that we have a basic understanding of A-world, we are ready to map out the basics of A-world science. To recover the basics of current science we would have to show first of all how the theories of General Relativity, Quantum Field Theory and Thermodynamics could fit in with our A-world model. Ideally we would then be able to reproduce the standard models of particle physics and cosmology, as well as the theory of biological evolution.

It should be quite clear that to derive any physical or biological theory from the considerations made over the last chapters is a mayor scientific undertaking and beyond the scope of this book. My goal for the next chapters is to let this task look less futile, so let's start with listing the impossible:

1. Starting from the 'topological' version of space from the last chapter, can we conceive a notion of a then 'metric' space, which would allow us to re-interpret General Relativity (GR)? First of course we have to find out, what exactly time is in A-world, as GR treats space and time as deeply intertwined.

2. Starting from the idea that our meso-cosmos of bundles of qualia grounds the micro-cosmos and not vice versa, can we understand what happens if we try to zoom in on bundles, and does this allow for a reinterpretation of Quantum field theory (QFT)?

3. Looking at thermodynamics, which through energy conservation and the entropic arrow of time seems to drive our material world; what would energy, entropy and information be in A-world?

4. How did we end up with the standard model of particle physics? Having settled the question of energy; what are inertial and gravitational mass? What is charge? What could be behind the other particle properties? How do the

four basic forces of gravity, electromagnetism, and the weak and strong force fit in? The catalogue of necessary explanations is far to long for anything but a full-blown scientific model, but can we at least try to indicate how possible solutions to the most basic questions would look like?

5. How did we end up with the observable universe? Having understood all of the above; can we illustrate how cosmology would look like in A-world? For instance, if we only have bundles of qualia, why all the empty space? And remember; a core feature of A-world was the pre-biological evolution of the material world - was this the big bang?

6. Furthermore, can A-world really account for the development of life in agreement with biological evolution? Up to here everything is a must have, but can A-world really help us to better understand humans by taking both their mind and their brain for real? How do we end up with what neurobiology finds about brains? And does A-world give us a hold on mental causation as a process at the non-/material interface?

7. Afterwards we will still have to ask ourselves, whether we actually did recover the non-material world. Particles, words and thoughts are the pillars on which human thinking has rested for long. A-world does not only re-think particles (as not grounding), but also thoughts (as qualia) and words (as we will see later). Even if we could make A-world science plausible, would this actually be a fitting description of the non-material?

Chapter 11

Our universe – As infinite as human stupidity

Our universe was born about 14 billions years ago from basically nothing, and expands – without a center or border – with increasing rate since then. We actually don't know how large it currently is, but the observable part is about 100 billion light years in diameter. The universe as a whole seems to be very homogeneous and isotropic (not directionally structured), and it's spacetime fabric is close to flat (we will later on try to understand what this means), and shows interesting features like black holes (singularities in spacetime), as well as gravitational waves (waves in the fabric of spacetime itself). It is to a first approximation just empty, with only a very tiny bit of it actually being occupied by 70% 'dark' energy, 25% 'dark' matter, and about 5% 'ordinary' matter, the latter mostly structured as clusters of hundreds of billions of galaxies with hundreds of billions of stars each. Besides gravitationally bound matter (gas and stars) we find diffuse radiation.

We actually know very little about the 'dark' components, but whatever they are, dark energy is suggested by the fact that the observed expansion needs a driving force, and dark matter is suggested by the movement of the observed matter in the universe. The number of planets in the universe is most likely in the order of the number of stars, which – given the large number of planets and the age of the universe – brought up the question, whether we should not have witnessed signs of other forms of life in the universe already (this issue is called Fermi's Paradox). Despite the plethora of phenomena in our universe, scientists have found a very small set of rules for their physico-mathematical description, consisting of not much more than a list of a few elementary particles (the exact number of which depends on how one counts) and four fundamental forces.

Bringing all these findings about the sky at night together into a consistent theoretical model was clearly one of the greatest achievements of humanity so far, starting from the ancient Greeks, then the likes of Copernicus, Kepler and Newton and continuing into modern physics. Our cosmological word view requires not much more than space and time, matter and radiation, as well a recipe of how gravity, one of the four basic forces in our universe, acts on the former ingredients. (The situation gets more complicated when we look at the early history of our universe. In the initial phases of it's expansion, even the basic forces where 'unified', and only much later sub-atomic particles and then atoms formed.) Classically understood, gravity acted as a force over distance, depending on the masses of the bodies involved and the square of the distance between them. Our current best theory to describe gravity is General Relativity (GR), which models gravity as a distortion of 'spacetime': It explains the observed gravitational force on objects through the deformation of spacetime itself by other such objects, thereby being able to accurately describe the indeed observable change of movement near massive objects and at very high speed.

Concerning not GR, but our standard model of cosmology, there are nevertheless a number of issues. Cosmology is first of all not in the same sense accessible for experimental falsification, as for instance particle physics is, where time and length scales allow for more elaborate experimenting. It is furthermore quite interesting how the remarkable accuracy of GR fits to the fact that 95% of the universe seem to not be bothered at all. (There is also a possibility that our universe is part of a larger multiverse of disconnected universes, an idea which came up in connection with Quantum Theory, to which we will thus have to come back later on again.) Despite these issues of cosmology, GR is basically uncontested; in the next chapter I try to explain why.

Chapter 12

Spacetime – Telling matter how to move

Despite the mentioned cosmological uncertainties, General Relativity (GR), the theory behind the standard model of cosmology, has to be considered a definite corner stone of our current scientific world view, because it has a remarkable account of making highly accurate predictions available. The successes include passing the 'classical' tests boldly proposed by Albert Einstein himself, concerning details of the orbit of Mercury, the bending of light by massive objects like the sun, and the redshift of light waves emitted from massive objects like stars, as well as numerous tests proposed afterwards by different scientists, including the prediction and subsequent experimental confirmation of new effects like not only gravitational lensing (bending of light), but also gravitational time dilation and gravitational waves.

GR was the magnus opus of Albert Einstein, based on his previous development of Special Relativity (SR). The later redefined our thinking about time and space: Based on the assumptions that physical laws should not depend on the state of the observer, and the experimentally supported one that the speed of light is a constant even for moving light sources or observers, he found that time and space had to be understood as coupled, as a unified 'spacetime'. If I move a light source, but the speed of light remains constant, i.e. the two velocities do not add up, space and time have to somehow account for this. To restore consistency both for traveler and observer, the former has to experience length contraction and time dilation from the perspective of the later. As a result, simultaneity becomes dependent on relative motion. This way, by properly accounting for the movement of light, Einstein was able to bring together classical mechanics and electromagnetism.

Only after the development of GR, SR was called 'special', as it did not consider the 'curving' effect of mass on spacetime, thereby allowing the treatment of only 'special' cases with 'flat' spacetime. Thinking about what happens not only when moving, but when accelerating objects, Einstein observed that one cannot tell whether one is free of forces or in free fall under gravitational pull, and concluded that gravity is a pseudo force like the centrifugal force, a force which appears to act on us, while we actually travel curved space (thereby illuminating also the equivalence of gravitational with inertial mass). The mathematical core of GR, the Einstein field equations, relate the geometry of spacetime to the distribution of matter in spacetime.

One consequence of the notion of spacetime is the resulting 'block universe' picture of an unchanging spacetime 'block', quite in conflict with our common idea of a passage of time, which was therefore called a 'stubbornly persistent illusion' by Einstein.

To start a reconstruction of the phenomenological content of SR and GR, I will try to show that A-world is in line with the basic features of these theories. (The ultimate goal would of course be to derive the Einstein field equations from the properties of A-world ...) In this process, the 'nature' of time and space and their relation is open to re-interpretation, but a number of features have to be recovered.

Quite early on, Hans Reichenbach has pointed out that by taking the speed of light as a constant, SR 'chooses' certain consequences for the structure of space and time, and that we could avoid the upper speed limit by forcing in turn all necessary changes on our model of space and/or time. But although we would formulate certain changes differently (and more complicated), the basic features would still be recovered. So what are these basic features?

First of all, both theories formulate a relational view of spacetime: Time and space are defined not in absolute terms, but by the relations between events. Secondly, time and space are coupled, and somewhat as a consequence, they are relative to movement. Thirdly, the speed of light is the conversion factor between them. And fourthly, time and space are coupled to the distribution of matter.

Relational means that space is not seen as a container, but completely defined by the relations between entities. (I should mentioned that above I have used the term in a rather loose sense, as there are indeed differences between being relational and being relativistic; GR and SR are not necessarily fully relational, but have a relativistic metric.) It is important to keep in mind that it is the scientific discovery of relativity which implies a relational metaphysics, not the other way around. And although we proceed in the other direction here, we can bank on the fact, that objective measurements are just not observed.

I think it is quite obvious that our A-world of bundles of qualia is inherently relational, but to explain how it reproduces the other basic features, we have to first understand not only what A-world space is, but also what time, light and matter means in A-world. So before we can continue on GR, we will have to do some additional investigations.

Chapter 13

A-world space – This sublime and moving space between those trees

Leibniz developed his whole world-view on just two principles: That of non-contradiction (implying the concept or law of identity) and sufficient reason (that everything must have a reason). In A-world, it is the material world which supports these principles and identity, with the later as a purpose and the former as consequences of this. Stable growth, based on a stable identity, requires rules of conservation and for change, and A-world realizes these through giving things a position in space and requiring them to interact via material causality.

To allow for proper material causality space needs some level of locality; it should allow for interactions with only finitely many elements (i.e. have a locally finite topology or 'countability' in metric space). To allow for proper conservation upon movement, space has to be smooth and have certain symmetries, for instance related to translation and rotation.

A-world space would thus have to be quite like ours, only that the number of dimensions don't seem to be fixed. Three-dimensional space is the standard for General Relativity, but the theory would also work with a higher number of spatial dimensions. String theories (as well as their 'unification' M-theory) for instance suggest that there are more, some of which are 'rolled-up' and therefore invisible to us.

Dimensionality is an accidental feature of A-world and as such it must have been 'implemented' by the workings of the agent population: To see and think in three dimensions would be a capacity, which all embodied agents would have acquired at some stage during their development. And the start of this process would not only have been the build-up of a capacity, but the actual arrangement of the material world in three dimensions.

So why three dimensions? Three dimensions could have started as the minimum viable and most reliable 'fall-back' solution and then economies of scale set in. Three dimensions are indeed the 'simplest' solution for a general 'embedding' of a graph (of relations between bundle of qualia) in a 'manifold' - a topological space, not yet with a metric. (A topology describes space-like relations in a qualitative, not yet quantitative way, like features of flexible objects under distortion. Such investigations were started by Leibniz with his 'analysis situ'.)

And as both the graphs and the embedding can be 'chiral', (not mirror-symmetric, like our hands), the exact way of embedding might be related not only to some very basic spatial features of matter, but also to some missing spatial symmetry features at this level. We will come back to this later on when we investigate A-world matter, as for now the more important question is from where we get a metric to add to our embedded graph topology to form a proper physical space. According to the relational view of space in A-world, the relevant parameters for this would most likely be related to the overall structure of the material world in terms of bundles and relations.

With having sketched-out A-world space like this, we could now attempt the heroic task of mapping out the geometry of A-world space to see if it could fit to our universe. First of all, we would have to find a suitable embedding algorithm (there is no unique solution to this problem, so that many graph embedding algorithms exist) Secondly, we would have to discuss possible parameters for the metric. And finally, we would have to formulate the resulting geometry in terms of 'line elements' to make it accessible to the existing scientific procedures. (Line elements are a way to define geometries in a general way, by giving a formula for the calculation of the distances between each pair of neighboring points. The line element for three-dimensional, 'flat' space is for instance just the square root of the added up squares of distances along x, y and z. The line element for not only a space, but a spacetime would include a term related to time and 'non-flat' spacetimes would correspond to modified terms.) So here we are with our first – scientifically accessible! – test for A-world: Can we construct A-world space in line with what we know about real space? Note that this project is not yet concerned with movement, or the speed of light, or the coupling to matter; it's really only the first step.

Chapter 14

A-world time – Then, after a second or so, nothing continued to happen

So far we have basically ignored a very important feature of our scientific worldview, namely that we actually don't take space or time as basic constituents, but spacetime. There are some voices in physics who want to claim time back as a separate, 'real' entity, for instance Lee Smolin, and there are also mathematical theories on how this could work, like for instance shape dynamics, initialized by Julian Barbour. Most unifying 'quantum gravity' theories actually take space as 'emerging' feature, like for instance string theories, loop quantum gravity or causal set theory, and this is also the case with bolder alternatives to current physics like digital physics, or the 'new kind of science' proposed by Stephen Wolfram.

At the core of these systems of thought is on the one hand the observation (quite like the before mentioned insight by Hans Reichenbach's into Special Relativity) that if space and time are coupled, then whatever change we are not willing to assign to time, can (and has to) be accounted for in space. And on the other hand there is of course the conviction that time is more than the 'stubbornly persistent illusion' it is in General Relativity. Often the goal is to solve the physical 'problem of time'; that despite relativity, Quantum Theories still rely on a view of time as universal.

Taking time as 'real' and shifting problems to space, thereby making the later a more complicated and probably also weirder concept, is I think well in line with A-world. 'Proper' (naive?) mental causation needs some space-independent form of before and after of events, and the description of A-world space in the last chapter should have made it clear that it is anyhow a mathematical mess for anything but the simplest models. (The later is not a fundamentally new problem; as long as we can stick to the simpler picture of Newtonian space and time, we don't bother to re-describe our world in the framework of spacetime: We don't design mechanical engines in the language of Einstein. Similarly, only few things would be attempted at A-world level.)

I see no way of having mental causation without space subordinate to time, but I think it should be possible to have spacetime in a non-/material model without mental causation; let's call this model B then and not worry about it further for now. (Philosophy would speak of dynamic vs static theories of time.) So knowing that separating time and space is doing harm, but not more than physicists do to themselves, we will stick to the separation at least for now. We still have to explain why they 'look' coupled, and for this we first need to find out more about A-world time.

We can talk about time as long as we understand 'temporal talk' of before and after, but what is the structure behind this? Time seems to be linear, directed and defined by a relation which describes the order of events. This order of events does on the other hand not determine a metric for time, as it does not define a length (or even the existence) of an 'instant in time' so that the sum of events might as well be of zero or infinite length. Additionally, the materially measured, 'objective' and linear flow of time does not seem to be completely congruent with time how we experience it.

In A-world, change, the feature that defines the order of events, happens due to mental causation by agents. As it seems to be impossible to define a rule for restricting the rate of change without having a notion of time first, agents would be free to induce change at any rate they like. Only the deeper purpose of growth could restrict the agents, by requiring them to sometimes wait for resulting change in the environment.

The speed of environmental change would depend strongly on the 'rules' of the environment: Material change would not only be 'slow', but rates for material change processes would also show some consistency, because of the quasi-deterministic global upkeep of the material relations by the silent majority of the agent population.

There would indeed be no definite length of an instant of time, but the flow of time would be defined by the order of events and therefore be directed. The material world would be the source of an 'objective', linear time, and this time could indeed be relative to motion, i.e. coupled to space: The more material change is taken up by motion, the less is available for additional material change. It thus does not look unlikely, that A-world people would formulate something like Special Relativity to describe movement at high speed in A-world.

Our minds, through being 'anchored' in the material world, and different also from the purely non-material, would have a complicated relationship with time: Those faculties which barely touch on the material could indeed show less congruence with the material world.

It is hard to overestimate to which degree physics is a physics of sight. To measure time intervals, we actually look at distances covered and convert them by dividing by the velocity of light. In A-world this comes as less of a surprise, because objective time is based on changes in the material world, i.e. by changes in the 'web of next relations'. Upon formation of three-dimensional space, sight became our master sense.

Time measured like this is a parameter of the 'frame' with respect to which positions change, which in turn is dependent on the movement of this frame. If I can't take anything as granted (as absolute), then everything is quite relative indeed. We would have to look at ratios of distances, times and velocities, with the later ones not well-defined on relational (as opposed to absolute) space.

Don't we have the option to use the ever-constant speed of light to build clocks in A-world? And wouldn't this upper speed limit be at the core of the material slow-down in comparison to change in the non-material world? We have to investigate A-world light in more detail, but for this, we have to talk about A-world matter first.

Chapter 15

Matter – Telling spacetime how to curve

Light, and electromagnetic radiation in general, consists of photons and is therefore what we called 'diffuse' matter before. Very often we exclude electromagnetic radiation when talking about matter to make a further distinction between light and 'proper' matter possible. We can then say things like matter emits or absorbs light under certain circumstances. Before turning our investigation to light, we will first take a look at matter in general.

The structure and change of matter (including light) can be described via Quantum Field Theory (QFT), which is another cornerstone of modern science. It tells us that our reality can be described by a universal 'wave function' and a set of (coupled, quantized, operator-valued) fields in spacetime, allowing for quantized ('packaged'), more or less stable 'excitations' (roughly: distortions) which make up our elementary particles, which then in turn make up radiation, atoms, molecules, crystals, amorphous materials etc.

QFT interactions happen at specific spacetime locations, but QFT's fundamental objects, the fields, are infinitely extended. (Initially, 'atomism' – the idea of matter consisting of particles – was advanced as the opposite of 'energeticism' – that some universal energy field is the fundamental element –, but QFT actually comes quite close to the later again.) The field 'quanta' are discrete and countable, they carry energy and momentum, and thus 'hit like particles' as Robert D. Klauber put it.

Unlike the earlier theory of Quantum Mechanics, QFT allows for the 'transmutation' of particles, i.e. that particles or sets thereof can decompose or join into other particles or sets thereof. It shares with other Quantum Theories their statistical, non-deterministic nature and it shows like these other theories a strong non-local element at the (sub-)atomic scale. (At this level, interactions can not be pinned down to definite locations in space anymore.)

To bring the seemingly disparate theories of General Relativity (GR) and QFT together (although one can image them working together, their mathematics simply don't fit) several proposals have been made, among them string-theories, which propose much smaller vibrating 'strings' as basic building blocks. Parts of the physics community have the feeling that one will never be able to prove any of these theories right or wrong, already because of the very high energies involved.

The effort nevertheless derives a great attractiveness from past successes in bringing seemingly disparate parts of physics under unifying mathematical descriptions. This includes not only bringing together falling bodies on earth with the movement of heavenly bodies, of mechanical energy and heat, but also magnetism, electricity and light within electromagnetism, as well as space and time, energy and mass, leading up to our current models of QFT and GR.

I think it is fair to say that after the theoretically predicted Higgs boson was indeed experimentally found, work on the standard model of particle physics has reached a state where things seem to be flawless, only that the 'particle zoo' seems quite arbitrary and there are so few things not fitting in, that we seem to have run out of opportunities for surprising discoveries to bring more order to the zoo. The standard model seems to be just right, only that it is doesn't seem like a full story.

What are the core elements of QFT to be reproduced by A-world science? The most important features we will have to explain are 1. quantized (particle-like) interactions, 2. indeterminism (the statistical nature), 3. transmutation and 4. non-locality. The standard model of particle physics dictates some additional requirements, i.e. several parameters have to be reconstructed, like for instance particle masses. These particles are currently just given parameters of the model, but how could all of this fit to A-world?

Finally there is one riddle left with all Quantum Theories; the measurement problem. Apart from a set of elementary particles and quantized interactions, these theories actually refer to what happens when people choose to measure things, which is an extremely puzzling feature for a scientific theory: Until our measurement, systems evolve deterministic, but upon measurement a probalistic update happens. (We get a certain value with a certain probability.) Furthermore, the deterministic evolution of the system is not only unavailable to us in the sense that we do not know the 'hidden variables', but in principle, and if hidden variables exist at all, interactions would have to include non-local ones. (Bell's theorem, the Wigner's friend paradox and many more discussions in physics and philosophy have sprung from these issues.) The measurement problem thus looks like a rather weird appendix to Quantum Theory.

In A-world I think we can again turn things on their head: It's all about the measurement. Remember, that A-world is not grounded on sub-atomic particles in spacetime, but that not only spacetime, but also particles are derivative features. A-world is grounded in the meso-cosmos of our experiences. We don't see particles or fields, we register changes in qualia. So what happens if we zoom in on them?

We split the bit in half and end up with two almost identical, smaller bits. And then again and again. At some point we chopped away all next-relations, but with them many more relations; we loose properties throughout the process. Finally we come to a point where we find – almost independent from what material we started – just basic patterns of relations between whatever qualia.

Now, are these basic patterns, these 'particles', defined by their remaining qualia? Not for us anymore; unable to sense them at all we just let these patterns interact with other, pre-prepared patterns, like when we shoot one particle on the other inside a particle accelerator. We don't actually care about the qualia anymore; we just found a very elaborate way to count the changing relations, by amplifying the results until we can make them accessible to us via changing qualia.

From changes of qualia we theorize about changes in physical quantities like mass and by taking these mathematical findings as substance, we 'see' particles. But can't we really see atoms? Not even QFT would say yes to this: We see quantized excitations joined into elementary particles making up atoms.

We encounter here for the first time a core feature of A-world: That our scientific approach works best if we can strip off all meaning and just count the change of relations, i.e. if we can come up with a mathematical description of change. But in the process we loose all meaning; our mathematical findings might be equally appropriate for atoms as for humans. We drop the infinite amount of information required to identify even a single quale within infinite qualia, and restrict ourselves to the finite amount of information about the number of changing relations, because such numbers are open to mathematical manipulation. A-world mathematics is the art of restricting non-material relations to material-like ones; when doing proper mathematics, we follow only those relations which guarantee (at least with respect to some features) material-like consistency for the outcome. This I think is also the reason for 'The Unreasonable Effectiveness of Mathematics in the Natural Sciences' (Eugene Wigner); it is build in by design. We simply don't call the other stuff mathematics.

The interactions of A-world matter are thus indeed quantized (from the countability of relations), statistical (from the statistical upkeep of next-relations), and they do allow for transmutation (if we put enough energy in to shake up the patterns of relations), and most likely also some micro-scale non-locality (as only our counting 'localizes' the patterns).

The parameters of the standard model would be consequences of which 'pattern' of relations was separated, but concerning the 'weight' of relations probably also of the global network; we will take a closer look at this later on with the examples of particle mass and charge.

Most importantly, the measurement problem would indeed be related to an actual process of measuring things: The world would not evolve 'unseen' at the micro-scale until we measure things, but it would evolve on the meso-scale, until we force things apart to 'count' what we have separated at the micro-scale.

Mathematically, A-world theory at the (sub-)atomic scale would maybe look somewhat like Relational Quantum Mechanics, an alternative formulation of Quantum Theory, which focuses not on objects, but the relations between them and models physical interaction as the exchange of information.

Chapter 16

Motion – A most obscure subject

Having established the response of certain patterns of relations as what we find as particles, we have to make it more clear how these particles would interact. For this, we commonly refer to forces between particles, but in our modern physical theories we actually don't talk about forces anymore.

The reason for this is, that because force is the time derivative of momentum, we just need the conservation of momentum to make things work. Additionally, the conservation of momentum, as well as energy and certain other particle properties are understood to be the consequence of mathematical symmetries in our physical theories,

According to Emmy Noether, energy conservation is the consequence of our theories being symmetric with respect to time, momentum and angular momentum conservation the consequence of our theories being symmetric with respect to space; and there are more such symmetries and conservation laws at the microscopic scale. Many 'avantgarde' physical theories try to further unite physics by generalizing this idea that everything springs from symmetries. As mentioned before, in A-world, the situation would be the inverse: Not symmetries lead to conservation, but the required conservation leads to a material world full of symmetries.

In current physics, the restrictions on physical processes which come with the requirement that certain physical properties are conserved can nevertheless be described as forces on ('fermionic', 'matter') particles, with these forces mediated through the exchange of other ('bosonic', 'field') particles. The conservation of elementary particle properties in the event of change is thus 'carried' by particles transporting portions of these properties, so that in the overall process nothing gets lost.

Overall four such forces can be identified. The force of gravity acts between particles due to their mass, the electromagnetic force due to their electric charge, the weak force due their 'weak isospin', and the strong force due to their 'color charge', with weak isospin and color charge thus being sub-atomic analogues of electric charge. As a result, the macro-cosmos is structured by gravity, the meso and micro-cosmos by electromagnetic phenomena, and the sub-micro cosmos by the weak and strong forces.

To position masses or charges etc. with respect to each other requires a certain amount of energy, which itself is not a substance, but rather the book-keeping device for how much change in one interaction will cause how much change in the other. This allows us to formulate models in which more than one of these forces is at work.

The overall energy of the world does not change by such shifts in the energy distribution, so that a lower energy state of a sub-system can not be the 'global' cause for the sub-system to change to this state. We thus need another quantity which tells us in which direction things are going and this is the entropy, i.e. processes happen, if the overall entropy stays the same or increases.

The formulation 'stays the same or increases' already hints to the fact that the entropy requirement is not forcing time forward, but that the arrow of time somehow forces the entropy requirement onto the material world. We will came back to this later on, but for now we will stay with just the energy.

Our current models formulate only one type of change as without energy cost; constant motion (in vacuum) is supposed to happen anyhow, once an initial energy investment was made. This is extremely important also with respect to the arrow of time: Only thanks to this, we have a final resting state of all things in the form of (sub-atomic) motion as (diffuse) radiation. And only through the availability of such a 'free' resting state do the other types of energy become usable in the way they are.

But what property of space propagates those particles endlessly? Conservation requires it, as a consequence of the symmetries of our theories. But like with causality before, for A-world we have to ask; what drives it? (John Locke, you remember, did consider the Newtonian system as incomplete not only concerning our sensations and cohesion, but also concerning movement and interaction: Why would particles move on forever and what makes them exchange momentum?) Now motion, the effect of forces, is a complicated thing in A-world, but we can assume that constant motion is free of charge in A-world too: It would be (like the exchange of momentum) the result of the regular upkeep of the next relations.

Chapter 17

Forces – Paying the gravity bill

Gravity, the first of the four forces we will have to consider, is special in that it has it's own theory, General Relativity (GR), which is commonly thought to be incompatible with Quantum Field Theory (QFT), the mathematical framework for the other three forces.

It is also special in that in GR gravity is not at all considered to be a force, but just the result of the geometry of spacetime: Mass curves spacetime, so that the straight lines of free movement just happen to bent around massive objects - this is why all bodies fall the same way. (Such curves are called 'geodesics', world lines of extremal proper – or on-move – time.)

To bring Gravity in line with QFT would mean to 'quantize' gravity, which unfortunately leads to an infinite number of parameters for the resulting theory. (Because the number of parameters depends on the energies involved, it would actually be 'non-renormalizable' only at high energies, while at low energies it would be just GR.) Experimentally one would have to find a 'graviton' elementary particle, which mediates the gravitational interactions. Gravitational waves are considered 'collections' of gravitons, but single gravitons are too tiny to be spotted against the background of 'neutrino noise'. Thinking the other way around, an *ad hoc* inclusion of GR effects in QFT has instead become a way forward in practice.

In principle, all forces could be understood as just the result of the geometry of spacetime: If mass curves spacetime, then why shouldn't charge? Such a geometric interpretation of electromagnetism was indeed shown to be possible and is known as Kaluza-Klein theory. Gravity is then only special in the sense that 'gravitational charge', i.e. gravitational mass, is assumed to equal inertial mass, which tells us to what extent a body resists a change of motion.

The core issue for electromagnetism is that charges exert forces (unlike mass) only onto other charged objects; charges curve spacetime only for those objects which are themselves charged. As a result, the Kaluza-Klein equations for electromagnetism are five-dimensional and electromagnetic interaction is thus mediated by a non-spatial relation (a relation outside of three-dimensional space), but the mathematical apparatus of this approach turns out to be even less practical than QFT.

So it is QFT how things are done and in the course of events the standard model of particle physics evolved, via feedback from predicted vs measured ’cross sections’ taken from particle accelerator experiments. (Cross sections are a measure of how likely elementary particles react with each other, a little bit like what effective size a particle must have to be hit by another one.)

QFT has known issues, mainly related to the question of whether the applied mathematical ’tricks’ to make it work are reasonable: Initially infinite parameters have to be ’re-normalized’ to finite values, but this procedure requires ’bare’ charges to be zero (with all charge coming from interactions) and bare masses to be infinite. The resulting equations still tell us that the vacuum is bursting of energy, 10*120 more than observed via the curvature of the universe, which is then fixed by the so-called ’normal ordering’ of states. Probably most irritating is, that when opposing charges approach, ’virtual’ particles of negative energy are exchanged. So even for electromagnetism, QFT does not make the sub-atomic order of things look especially reasonable, let alone meaningful.

The QFT equations for electromagnetism can be extended to include the so-called ’weak’ force. During the investigation of beta decay (a certain type of radioactive decay), scientists were not only able to identify two new particles (the neutron and the neutrino), but they also found that parity conservation was violated; electrons have a tendency to be ’left handed’, i.e. do not behave symmetric with respect to ’weak’ particle interactions. Given the fact that almost everything else conserves parity (through reflection/inversion symmetry, i.e. that space is isotopic, directionless), it remains one of the mysteries of the standard model, why the weak force does not.

Extending the ’electro-weak’ QFT model to also include the strong force (which confines quarks into protons and neutrons and binds them together in atomic nuclei), is possible in the sense that similar equations can be applied, but beyond the mathematical apparatus, this proposed unification of forces lacks in some sense a physical meaning. As mentioned before, the final unification with also gravity into a ’theory of everything’ seems to anyhow be doomed, because of the mathematical issues with quantizing gravity. Several alternative theories try to approach this problem of ’quantum gravity’, also because it is believed that the initial development of our universe could only be described by such a unified theory.

The standard model is thus well-established, allows for extremely accurate predictions, which were again and again corroborated by experiment, but does nevertheless not satisfy the purists. It supplies us with a list of pointlike particles (quarks and leptons like the electron) which are defined by a set of basic particle properties like mass, charge, spin, color, weak isospin, etc., where the exchange of some particles, like photons and other 'gauge-bosons', account for the interaction of particles. Successes of the standard model include for instance the prediction of the top and charm quarks, or the Higgs boson. There are on the other hand some irritating features, like the mass-range found for similar particles with different 'flavor', the above mentioned parity violation, as well as the fact that the parameters seem to be somewhat 'fine-tuned' to allow for a universe at all. Overall, 19 parameters long for further explanation.

String-theories (with M-theory as a generalization) try to explain such parameters of the standard model, like the ratios of masses between particles and the value of the fine structure constant, by proposing the existence of vibrating strings at a much smaller scale. Electromagnetic interactions would correspond to open strings, while closed strings would mathematically fit to gravitational interactions, thereby showing a way towards a theory of everything. Also due to the problem that experimental identification of such particles might be forever beyond our reach because of the high energies involved, the prospect of string theories seems far from settled, with much criticism also within physics.

Physics certainly doesn't need a new model to add to the complexities, but A-world does not aim to satisfy physicists so much as people worried about the mind/matter gap. For my discussion here the important thing is that QFT and the standard model are an extremely elaborate architecture, but rather far from being a final theory of the material world. To recover the proper physico-mathematical findings from anything but QFT is a heroic task, but it has several times be attempted and almost every attempt helped to further illuminate the situation.

Here we should find out whether A-world can be able to accommodate QFT at all, and I believe that nothing so far speaks against it. But how could we imagine gravity, electromagnetism and the weak and strong forces in A-world? How could specific parameter values for a standard model arise?

In a fully relational model, property ratios (e.g. mass ratios) are not necessarily well defined, but in reality we can for instance 'read' mass from acceleration. The option we have, it seems, is that finite particle properties are defined globally, for instance that the weight of the single next-relation is defined by the overall number of them. (Mass and charge are associated globally with fields also in our current models). If the property ratios between particles would stem from them consisting of smaller units, these units would have to be allowed to be much smaller to account for the fact that some of these ratios are far from being integers, like it is the case in string theories. In A-world this would mean that the pattern of relations we register as particles would even for the most basic elementary particles consist of quite a lot of relations.

A-world gravity would be deeply connected to A-world space; mass would curve space because of the many relations massive objects would have. We will revisit the idea when we try to find out more about A-world mass later on.

A-world electromagnetism could be interpreted geometrically too, but because the web of next-relations would relate to gravity, electromagnetism would have to 'see' additional, non-spatial relations, showing up as the additional dimensions in geometric theories of electromagnetism. The attraction or repulsion of particles of opposite or like charge could anyhow still be interpreted as distortions of space, in so far as the additional relations would have to have some influence on the upkeep of A-world space. We will take a closer look at this in the next chapter, when we investigate A-world light. As we see from Kaluza-Klein theory, such non-(3D)-spatial relations are not obviously less reasonable than action-at-a-distance via a field in classical electromagnetism or the exchange of virtual particles (sometimes with negative energies and opposite momenta?) in QFT.

A-world theories for the electromagnetic force most likely look more like S-Matrix Theory than QFT. S-Matrix Theory was a predecessor of QFT, which went out of fashion upon the turn to quantum gravity. It proposed a whole zoo of particles, related just by consistency requirements, and held together by forces from the exchange of other particles.

Finally, the micro-cosmos forces of the weak and strong interactions would point to the very fabric of A-world. Once we 'un-bundle' bundles again and again we will reach a point where a further un-bundling would effectively remove all material properties from a bundle. This would most likely not happen gradually, but reach a turning point at some stage. In A-world, when zooming in as far as we can, we don't find basic building blocks, but things just vanish; A-world really is grounded in the meso-cosmos. The strong force could be what we experience, when we try to entangle the relations which keep things in the material world. Because as some point a large number of relations is suddenly cut off, huge energies would be involved.

And the weak force? It's far lower strength points to a rather different origin. With the basic fabric assigned to the strong force, gravity to spatial and electromagnetism to non-spatial relations, the one feature of A-world not yet assigned would be the embedding of the graph of relations into three-dimensional space. And for this we would indeed expect only minor effects manifesting as 'pseudo-force', which in addition could very well show parity violations, due to the possibly chiral embedding of a possibly chiral graph.

In A-world, a real unification of forces is not possible if one looks at the material world only, because each force acts on a different level of reality. I will try to investigate gravity and electromagnetism further in the next chapters, but I think we have to postpone the corresponding investigation for the weak and strong forces until someone was able to come up with a mathematical model for A-world space.

Chapter 18

Light – Darkness cannot drive out darkness

We understand light as photon particles joined together (something which only light-like particles can do) into an electromagnetic field, which is described by it's propagation velocity (the speed of light) as well as characteristic wave properties.

Fields are one of these things which started as pure mathematics, but became substance at some point: A purely mechanistic world-view assumes only local interactions, essentially by particles hitting each other. But already for the movement of planets, people found forces at work which presented themselves as action at a distance. Isaac Newton's suggestion of gravity as such an action at a distance was met with great scepticism, and he accordingly sold it as a hypothesis, on which further comment could not be given for the time being. Now if you have different interactions at a distance, for instance the gravitational pull of two planets, or the attraction or repulsion of two charges, you can sum the influence they would have on a third object for each point in space, and this results in a field, first as a purely mathematical tool.

If the interaction is not instantaneous, but propagates with finite speed, then variations in time at the source will translate into variations in space: We move our hand back and forth into water, thereby sending waves over a lake. This time-delayed interaction comes already quite close to a field as substance. The concept of the classical electromagnetic field (which has no 'aether', no 'swinging' substance) is nevertheless puzzling. You can for instance ask where the energy is 'stored' within a field? Poynting theory gives us a way to locate the energy, but there seems to be no unique way to do so, with often somewhat weird results.

And modern physics has taken the concept of fields much further; it is the field which is the substance, and the particle only a localized 'distortion' in this field, and the interaction is mediated by other such distortions. The problem of action at a distance is solved, and the quantum nature of the micro-cosmos can also be recovered via 'quantized' fields.

In the last chapter we said, that A-world gravity is related to the 'spatial' interactions of bundles of qualia (we will take a closer look at this when we investigate A-world mass), and that A-world electromagnetism is related to 'non-spatial' interactions, which nevertheless have some influence on the spatial arrangement.

But what is meant by non-spatial relations? Going back to the basics, which in A-world are the meso-scopic bundles of qualia, we find apart from a spatial order also things themselves as ordered. An object is made up of it's properties (including spatial ones), and shows as such some cohesion.

To take things apart, we have to invest energy to break these relations - but how does this meso-scopic cohesion transfer to the micro-scopic world? It has to show up as a force between parts which belong together at the meso-scopic scale. The force would be spatial, but the cause is not; the relation would be 'non-spatial', although the effect can be located in space. In A-world, electromagnetic interactions are the 'shadow' of the non-material world.

We could for instance assume that besides 'is not' relations, which are the basis of the spatially 'well-ordered' next-relations, we would have something like 'is part of' relations as structural elements in bundles of qualia. These relations would still be material and therefore subject to material (consistent) upkeep, but they would not be spatial anymore in the sense of the web of next-relations. We would thus have a boundary layer of material but non-spatial relations, between purely material/spatial and non-material/non-spatial worlds.

But how could a non-spatial relation cause the web of next-relations to change? Without such a change in the geometry of space, no corresponding causal upkeep would happen, and the electromagnetic force could not have 'mechanic' effects. We will investigate this question in the next chapter and stick to purely electromagnetic, non-spatial relations for now.

Persistent electromagnetic interactions are realized in the material world via charges, and in A-world such charges could be realized (unlike next-relations) via self-relations on one side ('is part of itself') as well as missing relations on the other. Both would occur when bundles of qualia are broken apart, and could then explain the possible transfer of charge away from their original bundles.

As mentioned above, the causal upkeep would include not only next relations, but also electromagnetic interactions: When 'charged' bundles would be moved in space, the causal upkeep would form waves in the web of not the next, but the non-spatial material relations. This 'shivering' of relations, once projected onto 3D-space, would be what we are able to register as electromagnetic radiation or light. (There would indeed be no material medium, no aether, for the propagation of light.)

In A-world, the speed of light is the maximum rate of change, with the value depending on the average reaction time of the agent population for the causal upkeep. As we found earlier A-world time units to have no absolute value, a finite maximum rate of change would arise only with respect to the finite material word (and most likely related to the overall number of agents involved).

Evolution equipped many life forms with organs to register light, and this ability proved to be so valuable, that our whole thinking is structured according to sight. We also know what we know about the microscopic world mainly thanks to electromagnetic radiation. In A-world, sight would have evolved on top of the earlier arrangement of the material world in three dimensions. Even without sight, relying only on their other senses, A-world scientists would most likely have not ended up with lower-dimensional physical theories. Though their senses would in principle be independent, and even without sight, greater powers would be achievable.

From the flow of information registered by our eyes, arises a new problem for A-world: How is 'material' sight linked to our 'non-material' experience of it? We will have to come back this later on, when we consider how A-world brains work.

Chapter 19

Energy and Mass – No light matter

Over the last chapters we already talked several times about energy, in the sense of how much causal power to invest to cause a certain change. Following this, A-world energy seems to be the book-keeping device with which to properly follow the flux of material relations. Energy conservation would then be the equilibrium of this flux, which requires that material relations can not be deleted or created, but only shifted between (or within) bundles.

As motion other than in vacuum would require the shifting of spatial relations, mass seems to be the outcome of a bundle having relations attached to it, (a set-up not completely different from the currently found Higgs mechanism, where mass is acquired from coupling to the Higgs field). Energy and mass would thus be as intimately connected, as our current models find and both would indeed be coupled to space, as GR requires.

Without further modification, our A-world universe would be extremely uniform, with a very homogenous density, so that little could happen at all. But what we find are all sorts of bodies with not only different masses but also different densities, i.e. mass per volume space.

In current physics, a higher mass comes from more particles, and a higher density comes from forcing them together on a smaller space. The a-world equivalent would be to have more next-relations cramped together within one bundle of qualia, still occupying the same 3D-space.

Because A-world implements 'mechanical' causal powers like in our real world as spatial interactions (changing next-relations, or 'particles hitting each other'), such an increase in available next-relations would also mean an increase in causal powers, or energy, for the bundle.

But it also means that the embedding of the graph into 3D-space can not only depend on the web of next-relations itself, but has to respect the 'internal' structure of the bundling of qualia into objects, i.e. the non-spatial material relations, the electromagnetic force. A higher density object would have a richer spatial structure inside but would still have no greater extension in 3D-space. This would translate reasonably well to our current models as to consist of more elementary particles, and as a result more spatial interactions within. As mentioned before, the required cohesion of bundles would be mediated by the electromagnetic force, now as a pseudo force resulting from the 'cramping' of space through the bundling of qualia. We will revisit this idea in the chapters on A-world mechanics and the gap.

To enforce meaningful causality, a direction for possible changes in the web of next relations is necessary; otherwise an intended action could not have foreseeable consequences. In A-world this direction would be implemented via a simple rule for the silent agent population, and this brings us to the topic of entropy.

Chapter 20

Entropy and Information – Arranging what we have known since long

One could think of two directions for the possible change of things; either towards higher or lower density (more precisely order), but the first one would lead to a much more stable – almost static – world, thereby not allowing for flexible, creative growth in the material universe. In our world life has grown to what it is, because it always had to fight annihilation. (While death doesn't make sense for us, it makes sense for life itself; new bubbles are bursting all the time – sad, but beautiful.)

So A-world entropy, as a measure of how homogeneous the web of material relations is, would stay the same or increase from causal interactions, with microscopic movement in space as the 'final resting state' of change.

Closely related to entropy is information. Thought experiments by James Maxwell ('Maxwell's demon') and Leo Szilard ('Szilard's engine') on whether one can use information to harvest energy (i.e. decrease entropy), and the experimental finding that this conversion of information to energy is indeed possible with Szilard's engine, posed the question of how 'physical' information is.

Energy conservation and the entropy relation were formalized as the laws of 'Thermodynamics', which (besides QFT and GR) is the third corner stone of our scientific world view. A detailed theory of information (and subsequently 'quantum' information) is available from the works of Claude Shannon, Peter Shor and others.

The latter is well applicable to physically realized (materially implemented) information, but leaves the issue of meaning and the relation between information and meaning open: To 'understand' material information (e.g. a chain of on/off signals), a framework of meaning is still required and simply pre-supposed in Shannon's theory.

As A-world already has a place for meaning, and our current theories work well for material information, is seems most straightforward to simply define A-world information as being always material information (something anyhow usually assumed in physics and information theory, but not necessarily so for a model like A-world).

Information could then be read from any change of material relations in A-world, and information would indeed be closely related to entropy and energy. (Irreversible operations on information like the deleting of bits would for instance be indeed accompanied by an increase in entropy, as Rolf Landauer argued. And information would not be preserved as energy is shifted around and entropy increases.) Registering relevant information would be the 'counting' of the change of relations between certain bundles, which would define the context by their actual meaning. While any single quale would stand for an infinite amount of information, as it's specification would be an identification of one qualia among infinitely many, material information would always be finite, as it specifies only the finite change of relations between qualia, which we nevertheless would have to be able to 'understand' to give any interpretation to the information we got.

We encounter here the same feature of A-world which we found for science: Information theory, like mathematical science, is the high art of throwing away all meaning (the qualia) and just count the flux of relations in the material part, with the countability itself explained by the evolution of the material world. Or as people have put it in response to Eugene Wigner's 'Unreasonable Effectiveness' claim: It actually shows not how much, but how little we know.

We are now ready to come back to our investigation of the differences between human (or in fact biological) and artificial intelligence: As machines are based on material causality, there are well capable of processing material information. But because they do not actively share the non-material world, they have no possibility to really understand context or go beyond a given one.

The human ability to form new (and good) hypotheses or rules is not based on following only material consistency rules, but to apply also different sets of relations, which are a feature of the non-material word, and which we will investigate in more detail later.

The important part here is, that they allow us to short-cut computations, though in the end we often have to adapt or revise them to really work in the material world, usually by implementing them step by step via some material detour. Our mind is thus not a quantum computer, but it also doesn't 'compute' the world bit by bit, it can move from chunks of meaning (bundles of qualia) to chunks of meaning without the constraints of material consistency requirements.

Chapter 21

A-world cosmology – A series of fortunate events

We have come quite far with our investigation of the A-world micro-cosmos, but we have to once more return to the A-world macro-cosmos: With everything (admittedly rather loosely) in place, we should now be ready to see if the observable universe and the proposed history thereof is at all compatible with A-world.

Our standard model of cosmology is called Λ-CDM, for it is based on dark energy, represented by the cosmological constant Λ, and cold dark matter, or CDM. It is derived from a number of observations, of which we have to make sense also within A-world cosmology:

First of all – though usually not necessary to explicitly acknowledge – the universe is 'full' of empty space. What is empty space in a relational world? It is just the possibility to make relations between bundles in different ways, or once embedded in 3D-space, no more than the opportunity to move with respect to each other. Stars then seem most remarkable in A-world, as why should they have formed with so little function for life? The history of our A-world universe will help us out later on.

Second, we observe a 'redshift', a change in the wave length of light from distant objects, which is explained with an expansion of the universe, in a a way, that all objects increase their distances to each other. One problem is that nobody has or ever will directly observe an increasing distance at the cosmological scale, because our life times are just too tiny to do so.

Accordingly people have considered alternatives like 'tired light' (scattering of light in empty space), or that time scales could depend on spatial distance. Both (and more) sound possible in A-world and would have be investigated as possible alternatives, like they are for our actual world, but none seems less free of problems than our current assumption of an expanding universe.

Accounting for an expanding universe would mean quite a thing for A-world: Agents would bring new next-relations into the material world, which so far we did not allow to keep energy conservation. We could maybe allow agents to do so only at an extremely small rate, maybe even just as errors.

At the current stage, tiny bits of space would enter the universe over gigantic length and time scales, but initially, this would have indeed looked like a 'big bang', as the addition of even a single relation in 'no' space would correspond to an extremely high energy supply. The continued expansion would lead to ongoing (now tiny) changes in properties like the speed of light or mass or charges of the elementary particles, but this is something which for other reasons was hypothesized also within certain physical theories.

An expanding universe has the benefit that it would help us to make sense of distant stars in A-world: Particles formed soon after the beginning and then subsequently went into the established production line for the formation of stars from gravitationally contracting clouds of gas. The formation of space together with material consistency let to the unintentional creation of distant stars - quite similar to how we currently think about them.

If we allow for the addition of next relations, should we allow for their deletion? If Errors happen on one side, why not on the other? Deleting next relations would mean to break up space, to let things vanish, and once such an error has happened it could be self-sustaining, with black holes coming into mind, though this is clearly far-fetched at this stage.

A third important observation is the cosmic microwave background (CMB), the left-over, diffuse radiation from the early development of the universe. It seems to be extremely homogeneous, which again points at an expansion of the universe, but there is quite some math involved in 'measuring' it (for instance to subtract the effects of foreground dust), so that some anisotropies, i.e. some directionality, might be lurking out there. A-world would have no conceptual problems with this.

A forth observation supplies us with a more detailed picture of the development of matter in the universe: We find a certain abundance pattern of light elements, which is in line with a formation of these elements in rather early stages of the universe, though there is again quite some math with parameters involved, and some abundances (He, Li) don't seem fully consistent with the current model. Again, A-world would not run into conceptual problems.

Finally, the observed distribution and arrangement of matter as radiation, gas or stars, as well as the therefrom proposed formation and evolution of galaxies, seems to be well in line with all of the above as well as with GR, as long as we allow for dark energy to 'power' the expansion and dark matter ('following' mass) to help with explaining the observed movement of galaxies.

Some interesting features are not full understood yet, like the observed structures of several, evenly-space walls of galaxies in two opposite directions or a certain periodicity in red-shifts, but the more substantial issues are related to the incompatibility of GR with QFT, for instance also concerning the QFT prediction of the cosmological constant (for the dark energy) being by a factor of 10**120 too high for the standard model of cosmology. We of course tried to illustrate the problems of A-world with both GR and QFT over the last chapters already.

Chapter 22

The challenge – Excellent! We can attack in any direction

Having investigated A-world cosmology and the A-world concepts of space, time, matter, including motion and forces, light, energy and mass, as well as entropy and information, we can return to our question, of whether A-world scientists would really invent theories like the ones we have to structure their observations.

Over the last chapters I tried to show that the material part of A-world is conceptually suited for the program of recovering modern science. But this means little in the light of what modern science is able to do, based on it's formulation as a set of mathematical models. The real problem will be to not only come up with a conceptual fit, but mathematical consistency.

So here we are with our set of scientifically accessible tests for A-world (the first of which we already mentioned as a teaser in the chapter on A-world space):

1. Can we set up a mathematical model for A-world space, find a suitable embedding algorithm and fitting parameters? 2. Can we extend this model to account for A-world elementary particles as what we register from specific 'distortions' of A-world space (and do they experience proper quantum non-locality)? 3. Can we come up with fitting rules for the 'causal upkeep' of A-world (especially concerning motion)? 4. Can we properly describe gravity, electromagnetism, and maybe even the weak and strong force via spatial and non-spatial relations, as well as the basic set-up and embedding of particles? 5. Are the A-world concepts of light, mass, energy, entropy and information consistent with all of the above? 6. Is there any chance to come up with the particle parameter values we find for the standard model of particle physics? 7. And finally, can we recover with the above the observable universe and it's history?

Alternative physical theories (of which many exist) are usually not bothering with points 1 to 3 or 5 too much, but focus on 4, 6 and 7, mostly in attempts to unite gravity with the other forces, and/or provide answers to the uncertainties of cosmology. Reproducing the standard model of particle physics is then a core issue, as here quite a number of parameter values have to be explained or reproduced.

Work on A-world science would nevertheless not have to start from scratch but could try to import insights and mathematical machinery from existing works as much as possible, for instance from shape dynamics, relational quantum mechanics, S-matrix theory, Kaluza-Klein theory, etc.

Chapter 23

A-world mechanics – But under us all moved, and moved us

So far we have been mostly on the defense. We tried to at least conceptually show that A-world is not totally unreasonable, but given all the issues we faced, what was the reason we wanted to go there in the beginning?

The reason was that A-word should be able to not only give a meaningful outline of mechanisms and machines but also concepts and ideas, and especially organisms, as well as institutions.

Material mechanisms would be working according to our considerations in the preceeding chapters and would thus be basically equivalent to the ones in our world. Their working would result from spatial relations, like things hitting each other in space and non-spatial ('higher-dimensional') electromagnetic interactions.

Once these mechanism are arranged in somewhat separated sub-graphs, they could - by limiting their interactions with other parts - work as machines and as such they would be more than their parts as they would show function. This would be closely parallel to our world, especially in that the emergence of functionality would be the same as in our world and well comprehensible.

In A-world it would still play a role that in a machine material mechanisms are arranged according to an idea or concept, and for the grounding of A-world this would be the more relevant thing: Turning things around again, what we have in A-world is a bundle of qualia, with a certain set of functions, which are realized by parts, which are sub-bundles. And if we look close into these sub-bundles, we might have to go through several stages, but in the end the bundles would vanish into single qualia, with the functionality – the causal power – implemented as spatial and electromagnetic relations.

So what about the non-material world? Agents can bundle also qualia which are not part of the material world, and the options are infinite, as no consistency requirements apply. We will take a closer look at these infinite opportunities over the course of the next chapters, but for now we will just state that the non-material equivalent of mechanisms could be called concepts; bundles of non-material qualia, which, if properly applied also offer a kind of machinery, but now first of all for the non-material world. And once we structure these non-material mechanisms we arrive at what one could call ideas, which derive much of their power from the ability of shared access. More on this later on.

Organisms seem to derive their power from living in both worlds, from bridging the gap between the material and the non-material: As a bundle of qualia with an agent, organisms are neither purely material or non-material. If we investigate an organism, we again find parts, and for simple organism these parts look almost completely material. (Institutions in turn could be understood as 'social organisms'.)

Investigating a person, we find parts which are mostly non-material, as well as others mostly material. The material parts of organisms are usually referred to as organs, and they can again be taken to be consisting of parts, and as for machines we will find that at the material micro-level, they are driven just by material consistency requirements.

But this is misleading; we intentionally stripped everything away and resorted to counting material relations - because it is so powerful for the understanding of the material world! What we miss out on is the existence of additional functionality, which is not anymore grounded in the readily comprehensible emergence of material functionality.

A machine has a defined material functionality, and even a plant seem to have little more, but animals and especially humans do have non-material functionality. They have brains, i.e. organs with access to the non-material world of qualia (sensory experience, emotions, thoughts) and these organs must therefore have non-material parts and functionality as well. And the influence of these non-material parts look like the incomprehensible emergence of functionality at the material level; consciousness, qualia, mental causation, etc.,

So now we've arrived at the heart of A-world mechanism; how does the interaction at of the material and non-material look like? Didn't we just shift things around until we ended up with exactly the same problem that we had in the very beginning, only now centered within human brains, which we actually tried to avoid?

Chapter 24

The gap – The question is there, whether we answer it or not

Let's step back for now: Machines work like people without conscious agency, driven just by material consistency requirements. In A-world machines form from parts, which derive their cohesion from electromagnetic forces. Their most basic parts are completely structured by such material, but non-spatial relations at the interface of the non-material and material world; 'particles' stick together due to their 'charges'. Once a meso-scopic structure is reached, the parts of this meso-scopic structure are again structured by material forces - but not completely so! A Person, an embodied agent, gave form to the parts and the whole, thereby effectively adding non-spatial relations to non-material qualia, structuring in turn the electromagnetic interactions. At this level, machines are more properly described as bundles of qualia. Even a machine is therefore not just a material thing, but a bundle of qualia and therefore only partly (though largely) in the non-material world. Machines work like organisms without agency, driven just by material consistency requirements, but organized under non-material ideas.

Now how could this 'finishing touch' of the agent, of cleaving the final few relations to the non-material, make up for all the difference between a pile of materials and a working machine? Given the material consistency requirements of A-world, it is impossible for agents to directly structure anything at the meso-scale from scratch. But once the agent is part of a body (and especially if it later on acquires tools!), the person won't have to do so; it can re-use the (giantly large number of) existing bundles, i.e. the materials it finds. And the more evolved it's faculty to reason is, the more it is able to make use of concepts to structure and thereby 'game' the material world. While building the machine it builds up both material and non-material relations.

Particles would have been the very first 'machines', structured by 'silent' agents. And with the blue-print for them available as non-material 'institutions', ever similar particles would have been build, differentiated only by their location in space. Through material consistency, atoms followed, planets, and galaxies, molecules, cells, as well as brains. This structuring of the world was possible thanks to non-material concepts, but it was not 'guided', but largely random: Non-material concepts where not picked up by any other reason as to fulfill the near-sighted drive for stable growth. The strongly limited 'reasoning' of the agents did not allow for anything else; A-world is a world of evolution, not intelligent design.

The accidental 'invention' of life provided agents with more leverage on their environments and therefore much greater opportunities for growth. And the similarly accidental 'invention' of the human brain functionality marked another giant leap in the agents faculty, to structure the world according to their ideas.

Almost all non-material qualia influence the material world only indirectly though the decisions of agents, but some 'at the interface' must have the power to structure it; how should they otherwise have any influence at all?

In A-world, the simplest possible change with influence on the material world would be a 're-bundling', a making or removing of a non-material relation, which results in a corresponding change of electromagnetic interactions, for instance as an electrical impulse in a human brain.

That agents can do such making or removing of relations is their defining ability, and manipulations on non-material relations are furthermore not restricted by spatial identity considerations. That changes in non-spatial relations at the mind/matter interface are related to electromagnetic interactions was argued for over the last chapters.

So here we have it: An agent makes or removes a non-material relation, which cascades down to the shifting of non-spatial, but material relations, i.e. inducing a change in an electromagnetic field. In the case of a change in the electromagnetic field of a brain, the agent will act at a much more abstract non-material level, and the electric impulse in the brain will be linked to a complex material machinery, but the above is the essence of how the 'gap' is crossed. (Note that this 'gap' only exists if we take the material perspective; at the level of re-bundling qualia, there is no such gap.) Nevertheless, in this picture, the influence of the non-material is extremely limited without a brain which can 'pick up' the tiny changes made, and even these require a sophisticated non-material structure. Perception would work the other way around; based on incoming information coded within brain-waves, non-spatial relations would be influenced, thereby inducing changes at higher non-material levels. (A-world people would worry about electro-smog, but not more than we do.)

Would any of this violate our current scientific theories? QFT, GR would be rather fine, but Thermodynamics? Energy conservation would require that the above mentioned induction of energy would require a corresponding loss of energy elsewhere; I see no problem with realizing this with an additional change of non-spatial material relations elsewhere. (And people have of course pointed out before, that conservation would be fine, if the brain would just shift around energy.)

Entropy would further restrict the possible changes, and the irreversible introduction of information would require entropy to not only stay the same but increase. I think the question would come down to whether one can have two (or more) different realizations of the same entropy level and I believe that in any meso-scopic system this would be well possible. (From the A-world perspective it would mean that the causal upkeep has to take proper care of a small distortion, which due to the underlying indeterminism has to anyhow happen all the time.)

Could rising entropy wash out the signal? Here (as always), the one-way conversion of electromagnetic interactions into the 'resting state' of microscopic movement, i.e. heat comes to our help. Rising entropy would be realized via the generation of heat, and not via a washing out of electromagnetic signals.

We will deepen our investigation of the interaction of the non-material and material over the next chapters, first by taking a look at A-world chemistry and biology, which both are not 'only' A-world physics at a higher-level, before discussing life, evolution and the human brain in more detail afterwards.

But before we go on I will take a second to answer to a worry you might have: So if we can realize our wishes through partly non-material organs, wouldn't A-world be a magic world? This would be very worrisome indeed. Fortunately, material A-world is a well-oiled machine, with materially emergent functionality as the the only 'magic' available. And as such, material A-world is a protection against the very existence of 'true' magic; allowing for it would open a direct gate into the non-material, thereby practically destroying the material world.

So yes, in A-world we can make things happen by wanting them, but this ability is necessarily extremely limited - and this is by design, as only material consistency gives coherence to our wishes! If A-world people would ever be able to invent magic, then it would have to work in the material world according to the underlying consistency requirements. We arguably invented this (rather modest) type of magic already: It is commonly called technology. We will later on discuss whether it is conceivable that we could move to a 'matrix', a place with a different set of rules for consistency.

Chapter 25

Chemistry and Biology – Colors out of space

For A-world chemistry, nothing much seems to change: It's basic theory could still be understood as physics operating at a 'higher' organizational level. An important focus of theoretical chemistry is the relation between atomic-scale structure and reactivity, which makes knowing the energy depending on the configuration of atomic nuclei a central goal. Chemistry's unique theories (like retrosynthesis) can then be seen as describing well-explainable emergent features.

But 'real-life' chemistry starts with the sensory properties of compounds; how they look like, smell like, what sound they make upon explosion, etc. These are all not just material phenomena but deeply connected to qualia, through which we register those properties and changes thereof.

A-world chemistry would thus rationalize material phenomena much like we do, but they would in addition wonder, whether there is not more to find out about how sensory impressions are connected to for instance chemical structure.

From A-world perspective, when de-bundling, we could choose to de-bundle in a way, which materially isolates a certain sensory property. Before this, it was a property of a thing. After this, if we would continue to de-bundle, we would enter the micro-cosmos, with particles that do not have the sensory property anymore.

But in between we have a meso-scopic bundle with not only the non-material sensory property, but also certain material properties, which we rationalize as being the (often non-simple) sum of the material parts of it's constituent chemical parts. Did the evolution of A-world life attach sensory properties to material structure on a purely random basis? Or is there more to find out about this?

For biology we would expect a greater impact, as it's subjects are at the heart of what motivated us to set-up A-world in the first run. And we already established organism as bundles of qualia with an agent, with it's parts, or organs, as mostly material to allow for causal powers in the material world.

It is important to emphasize that current scientific biology is in no need for such an extension of the model, but that this is well in line with A-world biology. As long as we operate in meaningful contexts, we do of course not have to worry about the non-material in biology.

We can investigate the physical and chemical, as well as the genetic, morphological, physiological features of cells, microorganisms, plants, and animals as well as humans. We can explicitly also investigate the material workings of neural systems including the human brain in A-world neurobiology.

It is only when we look at the role of the non-material, for instance how qualia fit into our picture of the evolution of sensory organs, or mental causation into our understanding of the human brain, when we have to add something to modern biology in A-world.

A-world neurobiology tells us how everything works 'below' a certain part of the brain, which is able to catch the tiny electromagnetic changes, that are barely a shadow of our largely non-material thinking. The full picture is that of bundles of qualia, which are only partly organized according to material consistency. To understand the 'magically' appearing electromagnetic changes in the brain we have to turn to the non-material, but after this, neurobiology needs no more than material consistency.

The role for biology in the larger scientific world-view is nevertheless a much more central one in A-world: The basic requirements for life to flourish through growth would be found underlying both the evolution of the universe as well as biological evolution. Through billions of years of random exploration, life would have structured the universe, and only subsequently the universe life.

Biologists themselves (e.g., Robert Rosen or Stuart Kauffman) have for a long time advanced views on how to extend the organism-as-machine picture. A-world could be a way to account for these ideas.

Chapter 26

Evolution and life – This ridiculous weakness

The core elements of our explanation of life are genes, cells, individuals (plants, animals, people), and (eco-)systems. The overarching theory to make sense of the above is the theory of biological evolution, which like the before mentioned physical theories has to be considered a cornerstone of our modern scientific world-view. This means that any failure to properly accommodate biological evolution would clearly out-rule A-world.

Evolution was able to take it's central place in biological thinking due to the overwhelming evidence which was found in support of it. Evidence for micro-evolution (small-scale evolution between few generations) and speciation (the splitting of lineages into different species) can be directly taken from the observation of natural populations, as well as from experiments on laboratory ones. Evidence for macro-evolution (the derivation of novel life forms) often comes from the fossil record and includes structural, as well as molecular homology; we find the same building blocks and patterns throughout. Evolution suggests that the development of life is going on for about 3 billion years now, and this is well in line with the findings of the earth sciences (geology, geophysics, etc.).

The pre-requisites for evolution to work (Darwin's postulates) are 1. that individuals differ from another, 2. that these differences are (at least partly) passed to off-spring, 3. that some individuals are more successful at reproduction than others and 4. that this is not just luck, but (at least partly) due to their inherited differences. It was only later on that these postulates where married with genetics, which supplied a 'mechanism' for variation and inheritance in evolutionary processes, as part of the so-called 'modern synthesis'. In the following it was possible to put each of the postulates to rigorous testing, with the result that indeed all four postulates were found to hold.

Over the last decades additional mechanisms of evolution were identified. Besides the above outlined mechanism of natural selection (which can act both positive, i.e. enhancing, or negative), the importance of 'genetic drift', i.e. the completely random 'selection' of traits (more accurately: alleles), is a central element of the so-called 'neutral theory' of evolution. It claims that genetic drift is actually the most important mechanism, a position which is supported by the clocklike evolution of certain genes, and which therefore now serves as a null hypothesis for the detection of (positive) natural selection. Additional mechanisms include the migration of populations (more accurately of alleles) and non-random mating, i.e. influences that can to some extend be related to the behavior of (groups of) individuals.

Modern biology has developed predictive mathematical models for all these mechanism, thereby establishing evolution as the central theory of biology, able to account for such wide-ranging and complicated phenomena as general as the tree of life, or as specific as 'life history' characteristics like aging, including also gene/environment interactions (epigenetics), human evolution, and the development of social behavior.

A very interesting case is developmental biology (concerned with the growth of individuals from birth to death), which was initially – also due to it's complexity – left out of the modern synthesis, but is now as 'Evo-Devo' at the forefront of research into the fundamentals of evolutionary theory. A central finding is, that tiny environmental influences on (especially early) development can have outsized effects later on.

I think it has become clear over the course of the last chapters, that because of the important role material consistency plays, there is no general disagreement between A-world and evolutionary theory. The details nevertheless matter and we should therefore again ask – like for our cornerstone physical theories –, which basic features of evolution A-world has to recover under all circumstances.

If we take Darwin's postulates to cover life in the form of embodies agents, and if we take genetics to supply the necessary mechanism for this, and also including genetic drift, migration and mating, A-world scientists would find biological evolution to be an excellent model for the material development of life in A-world.

But while material consistency is a basic feature of biological evolution which A-world is well able to account for, another key finding of the theory of evolution is that adaption does not only lack foresight, but rather lags at least one generation behind, and that evolution is thus no progression towards perfection: It is all the outcome of random variation and material consistency requirements. That this is in line with A-world, is probably not equally obvious, but nevertheless the case, as I will try to explain in the following.

Chapter 27

A-world evolution – Blossom on the tree, you know how I feel

The question comes down to what are agents able to build intentionally. Simple agents would be extremely limited in what they can 'want' in the material world to happen, first of all due their very limited power to change a significant number of non-spatial relations, but even more strongly so due to their limited outlook on the material world.

Almost all agents could not be considered life, i.e. properly embodied, but just weaving on the fabrics of space and causality, according to simple rules realized via a simple non-material 'apparatus', that developed as the result of eons of random exploration. (Note that this apparatus can be to a large part the same bundle of qualia for all agents, as non-material bundles have no spatial location and are therefore accessible for all, so that it was indeed possible to establish a 'global' set of rules.) These agents do not interfere with biological evolution, they rather supply material consistency for biological evolution to work.

Some agents will relate to other qualia or bundles thereof and might use these as ideas to grow further, to build more complex things, like the simplest building blocks of matter. From the material point of view, the relation to these bundles would not act as recognizable forces, but just as opportunities to structure things, because their influence on the material world is limited to what agents make of them to structure the world. As we noted before, it is practically impossible for simple, or in fact any agents to make the tremendous amount of electromagnetic relations needed to build anything on the meso- or macro-scale from scratch like this, especially while fighting entropy at the same time. This means that almost anything beyond the (sub-)micro-scale must have developed due to material consistency only, i.e. according to the known rules of modern physics. And that is what we observe in cosmology:

The 'mindless' formation of gas, stars, and galaxies.

Accordingly, also the formation of early organic molecules would have to happen by pure chance, before with the rise of more complex biological life forms, agents became first better informed about the world via sensory organs and then more potent via the complex machinery of embodiment. Intentionality slowly crept in, but not in some magical way; freedom was for billions of years restricted to reacting to a certain stimulus slightly quicker or slower with a pre-organized response. But every opportunity for assumed growth was taken, and that's how A-world mechanics does indeed have an indirect, though still not magical, impact on evolution: Agents don't have any direct influence on their material constitution, but they have a certain influence on their behavior, although how big this influence is, depends again on their material constitutions. Humans, at moments when not driven by material (or non-material) mechanisms, seem to have acquired an astonishing bit of it. And it still doesn't work like magic; it is the ability to re-arrange bundles of qualia in ways, so that material consistency can do it's servile service.

So even in A-world, adaption does not have foresight - until agents have acquired what it takes to reflect on material consistency, at which point the human species entered cultural evolution. I believe that this result is not inconsistent with biological evolution, but gives rather more weight to it by taking away the burden to ruminate on human culture. (Thomas Nagel has recently argued against biological evolution, in that consciousness, cognition and values remain outside evolutionary rationality; A-world is showing us a path to bridge the divide without going astray.)

Up to here we have looked at the evolution of life from a material perspective, from bottom-up so to say, but A-world does also allow us to take the perspective from top-down. Life as a specific bundle of qualia is always more than just a body, but also a mind, and the border between the two is quite blurred. Taking organisms apart, A-world scientists would not be surprised to see that materially relevant features would have a material basis, which would include the genetic equipment relevant for variation and inheritance. Developmental biology would most likely be at the center of their interest, as material capabilites would have to be realized in tandem with non-material ones, to make them of any use for agents. It would indeed be of utmost importance that complex organism would grow in a way that would allow the initially extremely limited agent to step by step increase it's control of the material part.

In A-world, the birth of an organism (though not it's development) would be as profane and gradual as it is suggested by modern biology, but in A-world also the somewhat unsettling first step from dead to living matter would come at no bigger surprise than each birth: Agents are ubiquitous and work on what makes them grow; if biological machinery is available, life comes into the world. To have off-spring at all was most likely the greatest invention of all (somewhat similar to writing in cultural evolution), and in A-world this invention was forced onto agents by entropy.

This brings us to a probably bigger issue concerning A-world and the theory of evolution. The assumed pre-biological evolution of a proposed 'silent' agent population is a core feature of A-world; but does it have any credibility to call this assumed process a type of evolution? Returning to Darwin's postulates we indeed find some problems with this: Agents will differ from another both by their attachment to spatial locations and differing sets of non-material bundles of qualia. But we have no reasons to assume that 'silent' agents appear or vanish, nor 'spawn' off-spring over time, so that we would have to define the process of inheritance in the sense that agents have the option to make use of bundles of qualia which were prepared by other agents. Some agents could then indeed be considered more successful in what would be the equivalent of reproduction: Based on more powerful bundles they would have an increased ability to build even more powerful ones, thereby increasing the likelihood that the bundles they prepared would be taken over also by other agents. (Remember that in the non-material world no conflict arises from this.) The mechanism of pre-biological evolution would thus rely on something more similar to memes than genes, but could, I think, be rightfully called to be a type of evolution. Does it still go on? Most likely yes, but on the time-scale of eons.

At this point you might have got the impression that A-world has a strong 'crypto-cartesian' character; that all thinking happens in the mind, which is basically independent of the body and steers it like a pilot. But this is not the case; almost everything the mind does have to be anchored in some way in the brain. And in the opposite direction, large parts of the brain have to refer to the non-material world. To understand why this is the case in A-world, we have to take a closer look at human brains.

Chapter 28

Brains – Check your head

At this point we are able to speak of A-world people as having both a body and a mind, of being anchored in the material world, but able to explore the non-material. Now, how are agents at all able to make new relations to the non-material? Non-material bundles of qualia are not individuated by spatial location, there is no near or far in the non-material world. In principle all infinite qualia are in reach, but on what basis are relations practically available to agents?

For simplicity we could assume that agents make relations to other qualia or bundles by using already available qualia as relations. (We are here not worried about how A-world came into being.) Whole systems of qualia would arise by this: Different colors would be in reach once an agent has the underlying 'color-quale' available. Different smells could be put into use via another relation.

As the non-material has infinite possibilities, we would have to interpret the occurrence of these systems not as being a pre-structured feature of the non-material world, but as being the result of the systematic application of a basic 'idea' behind each of them. The agent population is thus responsible for both the structure of the material world, as well as the perceived structure of the non-material one.

Bundling in the non-material world is not restricted by any logic and wild jumps of creativity are possible, but most would be of no – if not harmful – use especially at the early stages of evolution.

Two important steps were, first to make use of the non-material to structure information about the environment of an organism in the form of sensory experience, and second to make use of the non-material to save some of this information for future processing via 'advanced' memory.

The structuring of information via sensory experience would correspond to attaching 'fitting' systems of qualia to certain sources of information, i.e.

to extend the material machinery of our sensory organs with a non-material 'apparatus' for increased efficiency.

Concerning 'advanced' memory, it is clear that 'simple' forms of memory can be realized already at the material level: If a neural system is optimized for certain automatic responses, this certainly is some form of memory. But with non-material bundles available, actively generated copies of bundles can be 'archived' by attaching them to the material world.

So we would find also advanced memory realized materially in our brains, made possible by the fact, that not the (non-material, meaningful) 'content' would have to be stored, but only the reference to it (i.e. material information), like an address in a register. Once the agents turns to the reference, it would be able to 'see' the (made-up) past.

The process of generating a consistent set of memories of past events should then be seen as a first step towards higher-order processes: The concept of making bundles of qualia available via links to the material world, in the process pre-sorted for relevance, became a design principle throughout: The material world does not only anchor our existence, it is also the channel through which we pick up new ideas. We can not simply plant our thoughts into the mind of others; material consistency prevents us from direct manipulation.

Higher-order processes include first of all consciousness and cognition. By design, agents would have the power to perceive qualia and to re-bundle them. An increasing sense of consciousness would be resulting from an increasing capability to structure and reflect upon their perception of the world.

Cognition would be the the material-anchored re-bundling of largely non-material bundles of qualia. In A-world a thought would not be something which we 'make', but which we perceive. It would be different to sensory experience in that it would be 'conceptual', i.e. not in direct rapport with material information, as opposed to non-conceptual sensory qualia.

All of this sounds wonderful, but does any of the above fit to modern neuroscience? Let's take a look at what we know about the human brain.

Neuroscience tells us that the function of brains is anticipatory regulation, which includes the control of behavior. This has important implications for the nature of our thoughts and emotions, as it requires brains to do nothing more than process information. The structure and function of brains is then the outcome of an extremely long process of 'evolutionary optimization' with respect to efficiency.

The energetic cost of biological information processing rises disproportionally with increasing amounts of information and quicker processing, which results in an important design principle for brains: Information should be transferred as little and as slow as possible.

As a result, brains are are organized in parts, with computations being made in parallel in many small areas, with certain areas like the Thalamus as centers for later integration. Nothing should reach a higher processing layer, that can be processed and returned at a lower layer. A lot of sensory information or motor control (and actually much more) does never reach our consciousness.

The mechanism behind these lower level computations have been mapped out in great detail by neuroscientists. Basic operations are realized via protein folding processes at the nanometer scale, we find intracellular circuits operating at the micrometer scale, and then neurons at the millimeter scale.

At the bottom level, computing is done with diffusion-driven chemistry and very cheap, but limited to smaller scales for reasonable processing rates. Longer distances are then bridged with electrical impulses, only that the 'recovery' afterwards is extremely costly in comparison.

For all of this, several trade-offs have to be addressed, resulting in cells tailored for specific purposes, concerning for instance their length, thickness, contacts to other cells etc. Another problem is that the whole process is rather noisy, so that signals usually have to be summed up, leading to further trade-offs. In this model, learning is accounted for by adaptive wiring, and also here the details have been mapped out in great detail.

A-world scientists could subscribe to all of what we know about the human brain, I think. The interesting bit really starts 'above' the layers we know so well about. An extensively investigated example is visual information: After following signals from the retina, through several layers and the Thalamus we still somehow lose track of what's going on higher up in the cerebral cortex.

There is no question that this observation could simply be the outcome of our very limited understanding of higher brain functions, but we would certainly find the same for A-world brains. Having reached a certain layer, the brain would still process information, but this information would be no more than references to what's really going on.

The 'maps' of functionality we find for brains would still be meaningful, but would have to be understood as mere 'shadows' of our thinking. Accordingly, the current situation, that we can recover correlations but not content through for instance functional magnetic resonance tomography (f-MRT) investigations, would have to be understood as the result of a principial limitation.

But also in A-world it would be the right thing to do, to continue to map every point of our brain to perceptions, emotions and cognitions, as this is also the first step to investigate the relations between the material and non-material at these points.

There are a number of initially somewhat puzzling features of our brains, which in my opinion should nevertheless *not* be considered strong arguments for A-world neuroscience. This includes for instance having holistic sensory experiences despite having separate sensory organs, or experiencing certain 'holistic errors' of information processing like severely distorted body images or split-brain consciousness. Having understood the layered nature of information processing in brains, such phenomena seem to be rather open to explanation at the material level.

Also most other characteristic features, like the brain's high performance from slow processing, the existence of a rather active resting state of the brain, (the 'default mode network') or the possibility of biochemically 'living' brains, without measurable electric activity are not in urgent need of explanations beyond those of current neuroscience. This should come to no surprise for us, as of course A-world was designed to first of all fit the material world and only kick in on the next level. And this brings us to our minds.

Chapter 29

Minds – I'm sick to death of this particular self, I want another

In A-world, a brain is the material part and 'anchor' of a mind, which itself is part of a bigger whole, an animal or person. For such a person to move or re-bundle is to move or re-bundle sub-qualia, which cascades down to the simultaneous change of a number of electromagnetic relations in the brain, which in turn then cascades down to change in the material world.

How free a person is to make a change, depends on the person and the person's environment: Agents are free to choose, but they are bound to material consistency, and can only think those thoughts which are in reach. The richer the material and especially the non-material structure of an agent is, and the less it is constrained by material or non-material requirements, the more free the agent is. We thus experience almost complete freedom when we face our least important little choices. But people can also be surprisingly free with strong forces acting on them, if they align with them.

Neuroscience is quite sceptical about the possibility of mental agency, although this scepticism seems to be routed first of all in the underlying scientific world-view of materialism. Benjamin Libet for instance showed that even before thoughts come to our mind, a certain activity can be observed in the brain, which is often taken as a proof that mental activity is the outcome of physical activity. But in A-world, the move towards perceiving a thought, would come before the though is present, which would be just one way to rationalize Libet's findings; post-facto brain activity would show that it is in effect (also) a sensory organ.

How effective a person is to make a change depends again on the means available to this agent. One critical point is how it makes use of environmental information. We said before that qualia would help to process information, if 'fitting' systems of qualia could be attached to the flow of information by the corresponding sources.

Based on the architecture of material A-world, a large number of possible sources of information come to mind: Signals from the variation of any material entity (including radiation) with respect to time and space, as well as signals from the variation between material entities could be connected with systems of qualia such as color or pitch. Movement of matter at different distances and length scales corresponds to the senses of touch, hearing, and temperature. Radiative variation to the sense of sight, material variation corresponds to the senses of smell and taste. Given the whole width of possible variations for each case, our windows of recognizable change are extremely restricted, thereby filtering for relevance. Some organism have much wider windows for some senses as an adaption to their specific needs. Many of our scientific successes were based on increasing our sensitivity for sources of information, like telescopy or microscopy, or on widening the windows available, like the vast zoo of spectrometries.

The attachment of systems of qualia must be understood as an evolutionary process, going hand in hand with the development of sensory organs. This explains also why it is not 'perfect' and why surprising mis-alignments occur. From the material perspective, through the attachments of qualia, agents had the opportunity to structure information at higher levels, thereby maximizing the impact of their limited material influence. (This is the part which looks a bit like quantum computing, but here the 'entanglement' is one of non-material qualia.) From the perspective of bundles of qualia, agents just bundled more effective structures.

In the same way, in which sensory experiences helped with the processing of material information, emotions later on helped to store critically relevant information: To effectively access and manipulate material information based extrapolations from past to the future, the qualia of emotions were attached to them. In many cases these 'instincts' allowed organisms to 'predict' what was going to happen in the near future. This helped them to make good decisions when rapid reaction was required, especially if the overall environment didn't change too quickly.

The next step up was cognition; which to a significant part means insight into material consistency. By relating qualia in a more flexible way to each other and the material world, it became possible to work on stored information. The first usage of tools a few million years ago was certainly an important step forward, but tools are also found to be used by some animals. It seems the level of abstraction first found with the production of early art a few tenths of thousands of years ago, that seems to be a more defining step for what is somewhat special about us. While material tools still have a clear connection to a specific ongoing in the material world, with art we started to freely explore the non-material. Besides the qualia systems that evolved with our senses and emotions, new important systems emerged: Music, language, writing, mathematics, science and much more. Can A-world theory tell us anything about the 'rules' of these systems?

Chapter 30

Mathematics – Certain reflections concerning the empirical

In A-world, many of the peculiarities of the 'systems of qualia' which we have developed should have some connection to the underlying structure of A-world. For sensory experiences, findings like Fechner's law (that sensation is logarithmically related to stimulus intensity) or that vision is indifferent to scale would not only have an explanation in the neurobiology of the brain, but also in a somehow 'fitting' structure of sensory qualia.

For some reason, following a certain relation, we would arrive at a certain next quale. And though it is the agents which 'pick' certain relations to structure the non-material world, the possibility of this structuring must be somehow immanent to A-world.

A scientific investigation would probably have to start with the 'simple' sense of taste, with it's set of only five different qualia: Sweet, sour, salty, umami and bitter for the most metabolically relevant molecular motifs of sugars, acids, salts, proteins and a whole set of bitter tasting things to avoid. Interestingly, we do have receptors for fatty acids, the third major nutrient, and the body thus can register the uptake of fat, but subjectively fat itself doesn't taste.

The sense of smell could be next, which is based on a few thousand molecular motif-specific scent receptors, but many mixtures of scents are experienced as new odors, so that the underlying system of qualia could be much larger (into the trillions?), and the relation between material signals and qualia as well the ordering of qualia would be much more complex.

We can probably imagine the system at the basis of our emotions to be somehow an analogue to our systems of perception, but starting at around

40.000 years ago, early 'figurative' art like cave paintings or figurine sculpting, pre-historic music, as well as burial rites reach a new level of abstraction from the material world.

A simple musical score reveals the full majesty of such constructions: It gives us a grand tour several times back and forth between the material and non-material, from composition to written down notes to the final perception. Pitch is a structuring quale in the system of music, as are rhythm and dynamics, but also sound 'colors' can be explored, and apart from these basic relations music seems to be wide open for further ideas.

Here we already see that A-world is not an unfriendly takeover attempt by the natural sciences: Music and other forms of art, philosophy, religion, as well as the humanities and social sciences have explored and investigated the underlying non-material systems since their very beginning. A-world allows to refer to them from a scientific point of view, but accommodates them as they are in the same manner as the natural sciences.

Two extremely powerful systems of qualia nevertheless merit further investigation here: One is language and writing, the other is mathematics. The later is in some sense the counterpart of the material in the non-material, while language is even more powerful, as it allows us to bridge the gap in numerous ways. But let's start with mathematics.

Early on, after having risen from the animal kingdom, and maybe out of awe in the face of the non-material, Philosophers like Plato took the world of ideas to be underlying everything. The world could accordingly be understood by the investigation of ideas, and numbers and such, the materials of mathematics, were taken to be real. And even today, mathematicians (and scientists) usually treat them as such, although some philosophers of mathematics have strongly disagreed.

In essence, we're still stuck at speculating and tinkering about, to capture whatever underlying structure there might be. People have tried first by mapping out in which way mathematics is just logic, then stepping back with formalism, claiming that mathematics is more generally the rule-governed manipulation of symbols, not necessarily according to a single, logical system. With intuitionism the idea came back that there are some sort of mental constructions.

Do numbers exist? The question is still wide open. If not, a number of other problems are open. Some concern vicious circles which arise in discussions within the Philosophy of Mathematics. Other are concerned with science, which often claims to be operating on empirical material only, but is actually far from doing so: The whole mathematical structuring of scientific theories relies 'blindly' on the assumption that the materials of mathematics are reliably available. Nevertheless, Hartry Field has shown how scientific theories can be re-framed without numbers, and in the Philosophy of Mathematics, modern structuralism claims to be fine with perceived mathematical patterns instead of objects.

On the question of mathematics, A-world would side with the likes of Kurt Gödel, who assumed not only the objective existence of the materials of mathematics, but even a non-material relation between some parts of reality, with direct analogies between physics and mathematics.

The non-material is not by itself all rational, and 'proper' thinking is therefore a high art. In the non-material we can, but do not have to follow relations; so what gives mathematics such a powerful grip on the material world? In A-world we can as always turn things up-side down; it is the material world which has the powerful grip on mathematics: Early mathematics consisted of those manipulations, which were in line with material consistency. The system of qualia which makes up modern mathematics then evolved with other consistency requirements as higher analogues. If we make moves with no relation to material consistency or it's higher analogues, we simply don't call it mathematics anymore. This in turn gives mathematics it's power over science: By design, every turn in mathematics is potentially relevant for the investigation of the material world. It allows us to map out the consequences of material consistency, without actually having to overcome material consistency itself. Modern mathematics has of course become much more than just that.

Chapter 31

Language – On the variation of letters

Even more powerful than mathematics is language, which for instance serves to formulate the former, as well as it's philosophical issues. Spread out over several fields, research into language is a complex field. In the process of the logical investigation of the world and mathematics, Philosophers became aware of the central role which language plays in our thinking and communication, and how complicated natural languages work in comparison to any formalized attempt. This so-called 'linguistic turn' somewhat overshot and suddenly the non-material was only language and language seemed to be the only thing to investigate in any case. Philosophy moved on, but several open question in the Philosophy of Language stayed with us.

In A-world, language is the ultimate tool. Using tools, we enlist both the material and the non-material to arrange parts of the world. Using language, we enlist again both the material and non-material to arrange parts of the world *together*. When formulating the wild possibilities of the non-material, language serves as filter for 'what can be said', i.e. what adheres to at least a minimum of relation to the material world. And when sharing this 'meaningful' bit of the non-material, languages allow us to produce the necessary material link, both for our peers as spoken word, or for following generations as written text. Languages allow communication via our shared, material basis.

A central question in the Philosophy of Language is, where words and sentences get their meaning from. (And later on, how do we learn about this meaning?) Is there a static link between content and word? Or is the link holistically defined by a certain position in a web of belief? And is the linking feature merely that of a definition or is there some historical causality behind? Formal languages, like for instance programming languages, are logically structured, but natural languages allow us to execute our intellectual ability to always step back or out of any system. Formal languages, as 'purely logical', can be formulated without any reference to meaning, but natural languages don't seem to work without. Any static definition of meaning seems to be doomed, but still at any point, there is a (or more) meaning to be found.

The meaning of words seem to be first of all defined by their history, which is 'kept alive' by a community of language users. (And this seems to stay essentially the same even if we consider that the meaning of words can greatly change between contexts.) But are there not 'natural kind terms' to be found? Terms that mark out entities in the world? Does the term 'water' not refer to the substance water 'in all possible worlds' (however it is formulated in your language and however this came to be)? Isn't then putting up words not like making a hypothesis? And are some of our creations not more fitting than others?

In A-world, we could make sense of almost all of the above discussion: An uttered or written word would have a flexible connection to the non-material, which again would have a flexible relation to the material world. There would indeed by a historically grown web of relations, but there would be some stability within; and this stability would arise from the objective existence of meaning, which could be (flexible) reference to both words and things, as well as much more in the non-material world. A-world would have it's own complicated Philosophy of Language, but I don't think that it would look totally different than ours.

Chapter 32

Values – The exact analogue of having a cause?

As wonderful a construct language is, humanity has risen to even greater heights. Having de-coupled their lives to some extend from material control, people soon attempted to make their existence more meaningful.

Now qualia only offer 'bare' meaning, but 'true' meaning in the sense we usually refer to is much more. We all can pick from infinite offers; meaning is basically everywhere. And though the material and non-material constitution into which we develop restricts and limits what we can make of us, no history could determine what to do in the light of infinite possibilities. We are most free when free of outside forces, which drag us back into the main streams of our time and space, thereby keeping us at the same time able to share with our others, but also somewhat blind towards those on the sides.

So do we pick meaning more or less randomly? No, because A-world has a guiding principle, and that is growth. And where the material world offered many options for growth, – once being bodily anchored and therefore save – many more options are available when we enter the non-material. But does our guiding principle induce some structure onto the search for further growth?

I do indeed think that this is the case: Our need for identity upon change requires us to recognize identity, to 'understand the world', to search endlessly, to strive for truth. Our aim to change our identity towards further grow, requires us to be 'being able to do the right thing', to help ourselves and others, to strive for the good. And our limited nature, our incapability of infinite growth, requires us to acknowledge the contribution of every little thing, to 'marvel at how things are', to strive for beauty. So while infinities over infinities are in front of us, our hunger for growth finds guiding posts within the void. And from these guiding posts, our systems of value arise; common sense, science and epistemology, morality, law and ethics, as well as art.

But doesn't this mean that there is one truth, one good, one beauty? Indeed it does, but not in the sense, in which we usually think about them. The 'core values' of truth and good and beauty are 'bare' in themselves, and what is true or good or beautiful at any point in time and space depends on what relations evolved historically. But because all three of them matter so much to our growth and because taken together they provide a coordinate system for us, they force us to grow also in our understanding of them: While we can see that there is truth, and good and beauty, quite what they finally (if ever) will be, we have to work out. As a consequence of marveling, searching and helping their way through the world, people found love and creativity, both concerned with people and things, as ideal intersections, and both have thus become central to the human condition. Only what they mean to us depends to a large part on everyone's unique position in the world. And in the process of revising the relations we attach to truth, good and beauty, to map out a consistent system for all three and love and creativity and many more, we grow to much more than the empty infinities of meaning from which life started.

A-world connects here to what scholars and activists are doing ever since, not in telling them what to think, but by conceding them the same 'ontological support' that the natural sciences always claimed, not for their single models, but for their overall search: They too operate on reality, not on some derivative model thereof. And although everything is wide open for discussion, we can not claim everything to be real growth. The details will always be as complicated as we find them to be for instance in philosophy or politics, but one safeguard is there: The same way in which our pain shows us limits, the suffering of others shows us limits for how to act on our beliefs. Pain and suffering are signals that we went wrong, that we have to revise again. Some of the final chapters of this book are dedicated to this.

Chapter 33

Philosophy revisited – The dead speak

If you have some previous experience with philosophy, you might have wondered since early on, if A-world is not just Plato's theory of ideas, Leibniz' Monadology or one of their modern successors in disguise. And I think this book can indeed be understood as trying to making sense of Plato's and Leibniz' thinking in the light of modern science, although it actually developed in a different way.

The works of such giants as Plato, Descartes, Locke, Leibniz, Kant, Gödel or Wittgenstein are core elements of western thought, usually extensive and always extensively discussed. I will accordingly try to make some connections visible, but it should be clear that a proper scholarly work-up of how A-world connects to earlier ideas would have to be left for those who have devoted their life to the study of those giants – if they are interested at all.

The first line of thought I will follow considers the role of the material and non-material in A-world. In this sense, A-world is indeed somewhat similar to Plato's theory of ideas or forms. Claiming that there is an eternal 'form' for every property a thing can have, Plato sees the physical world as merely a shadow of this world of ideas. We already pointed out that such a world-view is riddled with logical issues, something which Plato himself seem to have acknowledged with his most enigmatic dialogue 'Parmenidis'. Samuel C. Rickless and Marie L. Gill worked out the details of the logical inconsistency of the world of forms, for instance that non-material entities can have contrary properties, and proposed that the purpose of Parmenidis is to enable the reader to fully grasp this insight from the theory of forms. In A-world we are fine with logical inconsistency (and scepticism), as long as we anchor life in the material world.

Note that for Plato there was no gap in our sense; there was no modern science, he did not have to rationalize the material, was in no need of mechanics at the interface. But after humans had risen from the animal kingdom to rational beings, now the non-material was taken to be real and the material as derivative, thereby overshooting and in essence laying the trap of the gap.

Leibniz is widely considered to be the last 'universal genius' in that he seems to have been able to not only overlook the complete intellectual landscape of his times, but in addition to contribute substantially to central parts of it. Given this, his 'Monadology' looks somewhat weird: Starting from 'monads', with the powers of perception and apperception ('appetite' or volition), and including god as so to say the 'highest monad', he develops a picture of reality in which time, space and substance are of derivative nature. Unlike Plato's, Leibniz' time saw the rise of scientific experimentation, thereby making Leibniz aware of the gap Plato had opened. Trying to account for both the material, as well as the non-material world, he saw non-contradiction (the basis for identity) and sufficient reason (and therefore volition) as fundamental principles to structure reality. And given this, the monad population was a powerful idea, recovered in A-world with the agent population, although now split from the infinity of qualia. Without qualia to act on, real interactions were impossible, but 'pre-established harmony' (predetermination) guaranteed the clockwork-like unrolling of events.

In more modern times we could turn to Gödel for a world-view somewhat similar to Plato's and Leibniz'. Gödel did not formulate a closed model of his world-view, but it is clear that he saw the non-material as objectively existing, and systematically connected to the material.

A second line of thought I would like to discuss here considers the gap itself. In the sense outlined above, for Plato himself there was no real gap; but his 'forms first' premise was the seed of the gap.

Once it was wide open with a doomed material world and an infinite heaven, Descartes tried to at least put them in relation. His proposition of a 'dual' nature of humans made explicit what started with Plato. His idea of a coordinate system, which allows to describe positions in the material world via numbers in the non-material, thereby connecting geometry and algebra, brought this thinking to work.

While his approach emphasized the power of thoughts, it was the dedicated application of thinking that made our thoughts 'obsessed' with the material: The nature of thoughts themselves was of no question, it was the material world that merited investigation.

Kant then is Descartes uncoupled, which unveils Plato's error: As our thoughts are bound to our categories of understanding, we can know nothing about the things as such, from which our thinking is separated by the now wide-open gap.

This puzzling thinking about what one is part of, but not, lead after the two poles of Hegel and Marx to further fruitful investigations of human existence (Kierkegaard, Heidegger, Sartre, and others), how to recover the world phenomenologically (Husserl, Merleau-Ponty, and others), as well as the irrational (Nietzsche, Foucault, 'postmodern' thinkers and others). Russell, Gödel, Quine, Wittgenstein and Analytical Philosophy mapped out many of the underlying problems.

In A-world the gap is bridged; there is no veil between us and the world. Things-as-such are unnecessary duplicates and meaning is our sole category; our 'Kantification' of physics has to go only half the way. We might be wrong, but this is because we went the wrong way when connecting the dots – not because we are fundamentally tricked. But scepticism reigns - the infinite, non-logical possibilities of the non-material do not allow for brazen theories: We simply see, but what we see is complicated and can not be explained within a finite system. In A-world, scepticism is not a problem of perception, but rationalization – well in line with common sense.

Quite clearly, in the end we get out what we put in: Science takes fields and lawful interactions to be grounding, A-world takes qualia and agents for this, and the results correspond to it. Pre-biological evolution takes the place of our basic physical machinery, which in turn took this work from God: To guarantee the basic upkeep of the world. (You can imagine A-world science as a mathematization of the natural sciences that could have evolved if we would not have discarded the substances and qualities of Scholastic Philosophy, but instead further illuminated their nature.)

At the early times of science, when god still had this place, it was god who, like modern science today, gave legitimacy to our trust in the world. To prove the existence of god probably gave more credibility to the system in which such a proof was possible, than to the anyhow obvious existence of the former. In the same sense I tried to recover science for A-world.

And taking another step back, the faith in one almighty, but good god was actually a gain in rationality, over the fear of mythological forces, in much the same way science was another, even greater gain in trust.

With A-world we would attempt to rationalize the irrational further, but we again only push it one step back: After not being directly responsible for the world anymore, but through the workings of impersonal natural laws, god could still play a role as creator of the infinite system of qualia, as well as the agent population.

Chapter 34

A failure – One wild and precious life

What did we achieve? Very little, of course. Though I (maybe) managed to let A-world look reasonable at the conceptual level of language, I clearly failed to show it's consistency at the level of mathematics.

Taking our human experience as more basic than our thinking, we posited qualia and agents instead of particles and laws as building blocks. Accordingly, time was considered real and space only derivative, to allow for meaningful agency and an objectively real non-material part of the world. Turning the argument about the causally impotent mental on it's head, we explained the development of the material world and the mind/matter gap with the 'pre-biological' evolution of the agent population.

We then set up a list of tasks (in the chapter 'Recovering science') and tried to work them out in more detail (in the chapter 'The challenge'), to show that A-world is conceptually able to accommodate modern science, and can further be investigated via scientifically accessible tests. Mastering these tasks would not prove that we live in A-world, but that a model like A-world would not be impossible, thereby challenging the common feeling, that our current scientific world-view is without alternatives.

Apart from this 'defensive' challenge, we also mapped out a constructive challenge, by positing a certain mechanism for the working of especially humans brains, namely that humans don't process information, but meaning, so that the higher layers of brain-functionality serve rather as a sensory organ for the non-material, with structures in the cerebral cortex working merely as a register for non-material content. Neuroscience would have to find out, whether the model of an information processing brain as an anchor for a mind full of meaning is helpful or not.

What harm did we do to modern science? Pre-biological evolution will surely look weird to many, but I personally think it to be a quite modest proposal in the light of the prevailing idea of many worlds theory in physics. Many worlds theory explains the indeterminism at the quantum scale with each quantum event splitting off a whole world from the existing tree of worlds, thereby leading to an unbelievable large number of physically existing parallel ones. Many worlds in addition can explain little more than quantum indeterminism, while pre-biological evolution serves as an explanation not only for quantum indeterminism and especially the measurement problem, but also for the mind-matter gap, for material consistency, as well as causality.

Apart from having to accept pre-biological evolution where currently no scientific explanations exist, little harm is done, as by design, A-world tries to recover physics, chemistry and biology 'as is'. One nevertheless troublesome deviation is having time and derivative space instead of spacetime, though the idea of course is that this conceptual difference should not be measurable anywhere. Biological evolution is one area where one would expect problems, but I hope I was able to show that A-world would accommodate also biological evolution as is, up to the part where humans managed to enter cultural evolution.

In what sense could next generation science profit from a model like A-world? In physics, there would be several implications on what we actually investigate at the micro-scale, as well as for our efforts towards the unification of forces. Probably most interestingly, A-world can make sense of the measurement problem. In chemistry, we would have the opportunity to take a very different look at properties. In biology, we would have the possibility to connect modern neuroscience with philosophical considerations about qualia, mental causation and scepticism. Most importantly, there might be a way to understand the human brain, also in relation to artificial intelligence. At a more abstract level, A-world allows to argue for the effectiveness of science, as well as the effectiveness of mathematics in science. Finally, it is a world in which ethics and esthetics have a proper place, and which is indeed as colorful and kind as ours can be.

So A-world is a failure – but it probably was a productive one. Some core 'findings' of these ruminations are: A unified material/non-material worldview needs unifying building blocks, which therefore have to be compatible also with the non-material, making space a derivative feature. True agency has to be a basic building block, and already Leibniz seems to have been well aware of the fact, that this doesn't have to be a drawback; a monad or agent population has high explanatory power also with respect to material consistency, including causal upkeep. (Natural laws are actually less well suited for this, because they do not apply to the non-material, which makes them a feature of the material world to be explained, rather than a unifying explanatory element within a both material and non-material world.) Taking the above as starting point, science should be re-thought as the high art of how to ignore meaning to just 'count' information.

In the end, I believe, whether we take god or current science or a new model as the core of our world-view depends on whether it helps us to grow. In the very beginning I claimed that a new model is needed to avoid a 'materialist deadlock', in which our ignorance and arrogance limits our prospects for further growth. In the final chapters of this book I will try to explain this in more detail. For this purpose, I will assume that maybe (most likely) not A-world, but some extended model will turn out to be possible, and how this could change what we think, feel and do in our lives.

Chapter 35

What if – To loose a world, but gain a soul

In the past, science empowered us to reign in the detrimental forces that lay beyond our control most often via technological innovation, embedded in social change. But the ecological, social and psychological challenges we are facing now are to a large part self-inflicted and thus possible to tackle only by growing up with them. People can't change easily, for biophysical, social and psychological reasons, of which our general understanding of the world seems to me the single most damaging factor, although of course for each individual other forces are in the foreground. The core problem is, that our world-view is dominated by materialism, thereby shifting our value-systems away from the non-material.

It is not that we would not believe in the non-material world: The way we act on our perceptions, emotions, thoughts and volitions clearly shows this. But we endanger our values and institutions, by pretending that their non-material parts have only derivative existence. And by putting our material existence first, we often decide against properly taking part in these values and institutions. In A-world, this is an objective loss of potential, even if it does not result in material loss.

Ecological damage or social inequality did not somehow magically come upon us. We failed to do better in so many ways, because we pretend for instance that it would not be a real personal gain to pay more taxes so that children don't die of hunger anymore or to keep the diversity of life. This is a remarkable change from our (admittedly idealized) 'religious' past, from which we can see that a different outlook is well possible. Materialism diverts us from seeing our planet and our societies as what they truly are: As joint undertakings, with the goal of further growth.

But surely there is a lot of damage done in the name of values? This is true, because people take their 'sub-bundles' of them to be absolute. In A-world, People can indeed simply 'see' values, but like biological evolution, cultural evolution is lagging behind and imperfect. Once we admit their objective existence, we will still have to work on our values too: The objective existence of values allows agents to structure them consistently under their prime intent of growth. But because 'bare' values lack practical meaning, they are historically vested with what people have subsumed under them. Values are open to change especially if the never-ending search for consistency between values has opened a way for further growth. To not allow values to change, is to prohibit further growth. But values are not open to arbitrary change, and pain and suffering are clear indicators that things went wrong.

The missing spatial individualization of the non-material means that we can really share the same mental objects, the same values. It also means that empathy is more than mirror neurons, and that we share the same non-material part of institutions, too. Well-running institutions must have something like a stable non-material core, which probably gets regularly 'updated'. And although materialism has an indirect view on institutions via material outcome, this core cannot be grasped at the material level. To keep our cultural institutions save and grow further, we have to move beyond materialism, which won't tell us why to stick to them and not instead game the system. And given that modern science has so much, but not enough to contribute to the problems we are facing today, going beyond materialism will extend science also for it's own sake, to stay relevant in a world in which critical thinking gets more and more under fire.

Chapter 36

Identity and gender – Born to survive

I like A-world also for it's more poetic aspects: With the world not build of identical particles, there are true, unique artifacts, as your children (and probably art lovers) will anyhow tell you: This stick is definitely not the one they sent you out to find! And like their stick, I, you, we are something rather than nothing; pieces of art. More specific, in A-world you are the sum of your free choices, though bound by your environment, as well as your own physical and mental capabilities; your history. As such we are all prone to spiral deeper into dependencies, so that it takes effort to change direction, and might even become impossible for some.

Many aspects of our identity are important to us because they made us who we are, and there's nothing wrong with this, but we can not assume, that further growth will follow this or that path which we have started to grow on. We have to be kind with each other. But we don't need to worry about change too much either; we as agents have identity in change.

In our real world, we try to pin down identity via properties. We have a certain height and weight, skin, hair and eye color etc. If we look at one single property, we might be easily identifiable as very small or rather stately, but the more properties we take into account, the more 'average' will each one of us look like. Being of such mediocre nature also means to belong to a certain group, for instance of small people, or in a more broader sense to be a human and not some other animal. Identification is thus selective and driven by psychological and social function.

Many such labels are used - and more often mis-used - by and for people; religion or culture, race or skin color, class and gender are only some examples. These labels are so broad that they obscure the huge diversity below and as such they often serve to discriminate people and justify inequality. The 'natural philosophy' driven enlightenment made emancipation from these labels possible, but it seems to have come an halt with todays 'culture wars' and 'identity politics'.

Interestingly, maybe even more than race and religion, gender has become a nexus for these disputes. This is understandable in the sense that a principal supremacy of races or skin colors is hard to hold up against rational inquiry, and that religion and cultural aspects seem less fixed to individuals. Gender as sex on the other hand seems uniquely defined by material circumstances.

In A-world this 'unique', materialist definition evaporates. Sex, gender and sexual self would be a core example of how the interaction of the material and non-material influences us and our social lives: In A-world we do not only find a socially constructed gender, but also an evolutionary constructed sex, and a developmentally constructed sexual self.

During biological evolution, the process of reproduction became structured under the principle of (not always, but often) two sexes. Allocating 'opposites' increased efficiency under the given circumstances, but this must be understood as a rather random opportunity, as one tool for further growth. The existence of the two qualia female and male allowed for this structuring, but material requirements drove the development. In A-world, male and female are evolutionary constructions from the attachment of these qualia to material features. As bare qualia, female and male initially lacked all further properties, but during biological evolution they became vested with both material and non-material features.

The material realization is what we would call sex, the shared non-material properties are what we would call gender, but in addition to this, individual development can defy both when structuring the sexual self in our minds. The analogue holds for sexual orientation, which gives a spectrum of at least six dimensions to take into account and considering all in detail, I guess many more will find themselves non-binary. The important bit is to realize that all these constructions are transient, and that (averaged over the population) their coupling seems to have been somewhat of an advantage in the past, but will not necessarily continue to be so. Even in the past their coupling was not perfect, which suggest that even then there were many ways forward.

But like social construction, evolutionary construction is self-enforcing; attaching male to certain properties gives male the attributes which then leads to further attachment of 'fitting' properties etc. Historically, materialism favored males, and males materialism. But at a price; to not allow for further diversity and different growth. That we have become aware of and allow for diversity is a cultural achievement, like standing up to slavery or fighting for women's rights. And although the 'bare' essence of male and female has little meaning to us, we will most likely not trash the whole system, but twist it;

I’m sure we will stick with sex, gender and sexual self as sources of beauty, at the same time embracing the full diversity of bodies. What then will be the essence of male and female to us? We will have to find out.

Chapter 37

Mental health – And sometimes it hurts instead

Like the brain, mental health is one of the few (somewhat) 'hard' scientific topics, that can be framed as a positive challenge for A-world: If the non-material exists, then both bodily and mental reasons are driving mental issues.

Currently these issues are mostly categorized from the 'outside': People have different entry points (their life history), some inner workings seem to go on, but it is exit points which define our lists of mental problems.

And these lists are rather long: Apart from trauma or aging related 'material' damage like dementia, and neurodevelopmental issues like autism, we find affective and psychotic elements like elevated, irritable or low mood ranging from mania to anxiety and depression, as well as distortions of subjective reality up to schizophrenia, and all of this probably coupled with sleep-wake, eating or somatoform disorders, substance abuse and self-harm up to suicide.

The boundaries between different diseases seem rather fluid, and co-morbidity (i.e. that two or more issues arise together) is wide-spread, which lead to a discussion whether there is not one spectrum underlying all of this. This in turn lead to the hypothesis that the neurobiology of brains is driving mental issues.

The discussion is unfortunately intertwined with politics. In some countries, the hypothesis that (at least some) mental issues are mere imbalances or deteriorations of the brain, is of vital importance to force health care providers to cover these illnesses. (The history of mental care in the US seems to be an especially sad chapter in this regard.)

Nevertheless, most issues seem to arise from a combination of vulnerability (which is usually understood as genetic and developmental, i.e. materially developed), stressful events and quite often the interplay with unhealthy lifestyle 'choices' like substance abuse.

Accordingly, a purely neurobiological explanation of issues, although in some cases surely correct, does not seem to be in line with the experience of the majority of sufferers; they usually attach of lot of meaning to what they are going through.

A-world would be able to accommodate both sides: Mental issues could start either in the material (as a result of disturbed development, physical illnesses or trauma, as well as substance use), but also more often in the non-material, as meaningful problems to address by the individual to overcome barriers to growth. Due to their coupled nature, both material effects, as well as mental processes could then contribute to a vicious spiral of negative influences on each other.

Emotions would most likely play a central role both by forcing us to explore the non-material in search for new solutions, as well as influencing the anchoring of content in the physical.

In most cases, mental issues would start in the non-material, but would manifest in the material brain at some point, at which psychopathology would be registered. Vulnerability (both material, but also non-material) would play a decisive role, as would stressful events, the very meaningful problems in front of us, and everything else that would power the spiral.

In A-world the high value of early intervention and of cognitive behavioral therapy (CBT) would be obvious, but one could also understand why at some point medication is without alternatives. There is maybe even a change to better understand how the spiraling unfolds; at what point mental issues get 'bodily encoded', and why this encoding can be broken with all sorts of bodily interventions, like rapid eye movement or drug-assisted therapy. Sadly, it would also tell us, when the material coupling is damaged beyond repair.

Most importantly, the meaningful conflicts behind mental issues could take center stage, without denying the important role of the material. For those who shoulder more hurt, this might mean to go beyond CBT and dissect their life history, to understand how they became who they now are.

The good thing is that in A-world the basic design principles of the world would be closely related to those which scientists found for the well-being of people, like for instance Aaron Antonovsky with his Salutogenesis: Meaningfulness, to marvel at, would come from the possibility to grow. Comprehensibility, to search for, would come from identity through change. And manageability, to help ourselves and others, would come from mental and physical causality. A-world is inherently habitable also for weird animals like us.

But especially considering abuse, we could understand why this is often of little help. We engage via the material world with both other people and ideas. Our body anchors our life, gives us identity and allows us to take part in our communities. Abuse like rape cuts through this world, cuts off lives from million paths to growth.

Even after recovery, the person might be in some part of their existence cut off from others, as it can turn out to be impossible to communicate the person's experience of trauma via our established material links to someone who has not gone through the same ordeal. This 'missing voice' is then probably at the core of what the person has to overcome for future growth.

People often turn out to be amazingly strong, to be able to grow against all odds. So what would make A-world people unbreakable? It is mostly the same what makes real world people strong. To have people and institutions to rely on, to have talents and skills, to be able to reach out, to keep an open mind, to have a brave heart, to find their voice, to start again growing towards something left to love.

The ones which learn to grow along steep, dark paths – sometimes with weird ecstasy – can become fascinated with the abyss, because it made them understand, that one can get catapulted not only from above to below, but also from below to above and then seek this opportunity. Often, these are the most colorful and kind people we know.

But if the longing turns out to be in vain, with a view of the world too distorted for success, wild thinking can become dangerous for the dangerously free mind, as well as for those whose ways cross with this person. If you have become a monster to yourself, if this is how to grow, things get dark.

When you are reasonably free in your actions, it's not hard to see how devastated, how damaged a person has to be, to see the path to growth in hurting others, and how many further opportunity for growth are cut off by this.

Being cut off from growth in some form would be a defining feature of mental issues in A-world. Anyhow, however good things are for us, we are all cut-off from infinite more ways to grow, which also means that however damaged one is, if one can turn the tide, there are infinite ways to really grow: Infinite hope is build into this world.

Chapter 38

Politics and economics – The price to pay for indifference

Apart from a responsibility for ourselves, one could expect that one would find an exponentially falling curve concerning our responsibility for others: Maybe half of our worries would then be about us, a quarter about our partner and our family, and less and less for friends, our colleagues, our town, state, country, and those beyond.

Interestingly, this does not seem to be the case. Most would for instance put the welfare of their children above their own, and the falling curve seems to spike at certain social units, like our family, our country, and the community of more or less like-minded nations. In A-world this would be related to the sharing of similar parts of the non-material world, which also leads to what one could call 'shared values'.

Problems of course arise, as we mentioned before, if we take our sub-bundle of values as absolute; as fitting for everybody and beyond future change. And such problems easily arise, because in A-world people simply 'see' their values to exist, live with people who share this view, and do therefore have little reason to question them.

Because of the importance of material consistency, a lot of disputes would arise about the distribution of material resources, which would in turn require to get some idea about the proper relation between societies and individuals. So far, I think, A-world is much in line with our world. But in A-world, people would also investigate, what the core parts of their values are, and what would have to change for further growth.

There can be no doubt that the development of democratic structures (though on a spectrum from electoral autocracy to full democracies) and market economy elements would have been equally successful in A-world as in our world, so that the proper relation between societies and individuals would also be discussed on the basis of whether these structures and elements should be organized in more capitalist, social-democratic or socialist ways.

Socialism binds the individual more closely to society, by giving him only as part of the whole, but takes also away responsibility with this, leaving the individual to be controlled by the state. Capitalism frees the individual by handing him over his little lot 'completely', but leaves many with few realistic opportunities, thereby mobilizing populist threads. Social democracy does not offer a simple solution to the dilemma, but only dispute, and the problem with this way forward is to 'sell' it to the saturated. In the past, the excesses of socialism and the successes of capitalism pushed not only capitalism, but also democracy and market economies. The more recent decoupling of political and economical elements, together with the rise of technologies for a more efficient control of societies, has put the question of which values to strive for at the center stage again.

In A-world the question would be what the core elements of these values are. People would probably argue for a constitutional state, which formalizes individual rights, including free speech and private property as the liberal core. And also because individual autonomy requires a certain level of economic security, the duty of all individuals to take care of their fellow individuals could be taken as the social one, institutionalized at least in the form of a well-functioning social safety net. Actual material redistribution would most likely end up to be open for change.

We could then turn to John Rawls' seminal Theory of Justice for arguments on the socially just distribution of goods: That liberty should only be limited upon conflict with the liberty of others. And that inequality is fine, if the worst off is better off than under equal distribution.

But in A-world this would not be enough: That only certain values seem to be recognized (those which are largely in line with materialism it turns out), makes the whole intellectual project of Rawls suspicious to conservatives. Families, nations, religions, as well as unions, NGOs, and social movements are powerful institutions, because all of them are assets for the personal growth of many, but their value doesn't show up.

Furthermore, these institutions make up a large share of the assets of many less powerful people. The powerful on the other hand seem to get whitewashed, while actually loosing not much. Somewhat telling, 'fair' is a notion which is most commonly applied by grown-ups for children.

And while the process of increasing material rationalization, optimization, and economization pretends to award power according to merit, it is not only that this is often questionable in practice, but that the system accounts only for selected – and often the damaging – forms of merit.

The pandemic helped us all to see real merit, to recognize again those core contributions to the functioning of our societies, which are easily overlooked. Implementing notions of such value in market value would also help to tackle 'social inequality' like we tackled political inequality in the past, and like we are about to tackle economical inequality today.

Some seem to suggest that one should keep value (materially) defined by markets, but soften meritocracy; this would be I think most deleterious for any society. (Interestingly they do not criticize the probably most destructive excess of meritocracy; two party systems.) Mariana Mazzucatu makes the much more reasonable suggestion, that not meritocracy, but our current way of assigning market value is the real problem.

And indeed there are no 'real' common goods for justice as (material) fairness. As a result, groups fight for 'their' common goods; identity politics is born as a label. But the main fuel of this 'tribalism' are religion and race and they have been here for ages; it is called identity politics only since it has stopped to work for the 'ruling identity'.

We all share much more than what divides us, but this can not be a call to silence the weak, but should instead be a call to the strong to share their privilege. So that to ask for unity is to not again silence minorities, only to avoid giving up privilege by aspiring to their good will.

Because values themselves are 'bare' values, discussions about power are inevitable. And activism, science and arts are needed, to prevent tyranny or corruption from staying in or taking control, by messing with education and media.

Every western individual has an awful lot of privilege in comparison to the many starving to death. In A-world, life was made possible by abundance sharing, the willful restriction of the silent agent population. And though as embodied life, we don't share absolute abundance anymore, we can still share quite some abundance.

We currently run our countries, almost as if our values don't exist: Election and policy results change with changing boundary conditions, as people vote according to their material interests, or out of protest against the flagrant material interests of others, and not their higher beliefs. In A-world people would work out and strive to protect the core (not the historically vested) values of their societies as well as the common goods they have been given or created.

And this of course does not mean to call for 'good' politicians, but to call for political and economical rules, as well as strong institutions to enforce them. And because we live in a material world, and everything we do is mediated by the material, this also means that these rules must aim to make market value a measure for real value. Values must drive institutional change, and we have to live up to them and act accordingly.

Chapter 39

Religion – To love and follow his direction

Religion is an interesting topic for A-world, as in A-world there is no question that it exists beyond mere belief; only what this means is quite open to doubt. It would have to be up to A-world theologists to find out, but we can make a first guess:

Whether god itself is a quale, maybe a central one, or the sum of it, or an all-powerful agent, or the creator of qualia and agents would be as open as things are in our world.

But In A-world, religion would be a powerful asset. It's core value of the world being a meaningful whole is a powerful driver for joint growth. Mythos and ethos (the stories told and the moral rules set) would reflect this.

Concerning ritus (the rites performed), A-world would of course be able to accommodate the whole range of different forms we find in our world. Their common theme would be to make time and space for humility, solace and hope in the face of our existence as only a tiny part of a meaningful whole.

Religion would be a community in values, a nation state of the mind, much what – in the light of fading religious interest – is now sometimes claimed for western culture. But with the vanishing trust in the non-material, religions were left with only material history to take from, and this necessarily back-looking attitude cut off many religious communities from further growth and enabled many grave wrong-doings including even sexual abuse.

Topics like afterlife and abortion would have to be discussed also in A-world. If souls are thought of as stable elements of identity beyond all, then A-world people would have souls, only that these bare agents would represent really only the minimum unbreakable core of us. ('That small, unbreakable you inside yourself') Humans are in need of working brains (and much more) for a personality, and material consistency would prevent any esoteric interactions.

The topic of abortion is as complicated in A-world as it is in our world. Quite similar to our current scientific world-view, life would arise not by some jump into existence through the addition of a soul, but by the slow growth of an ever present agent into the material world. No definite point in time could be found to be fine or not fine for abortion for this continuous process of change from matter to life. Depending on our definition of life, different decisions could be justified.

In the end it seems to me, that the only person who could, who would have to be entrusted with the decision, is the pregnant person. As in our world, to prevent abortion would mean to prevent rape and incest, to organize basic supplies, health care and education for families, to sex educate, and to empower women in general.

A core function of religion was to unite for a greater good, and an important part was to supply solace and hope in hard times: Faith allows hurt people to grow despite their hurt, especially also by helping others. In A-world hurt would arise from the cutting off of opportunities to grow, for instance by trauma or loss. As mentioned before, such 'damage' would not mean one is not a full person, as any person is limited in numerous ways. Religion would help us to see this, thereby showing us how to persist in hard times.

A-world accommodates traditional values, but also the need for change. If different attitudes towards change lie at the heart of the culture wars, then A-world would show us a third way. We would have to ask, what are the core values and what is historically vested.

Christianity for instance is at the heart of western civilization, but characteristic is not a 2000 year old practice, rather a (of course greatly lagging) re-newing of it in the light of modern thought. It looks to me that only two beliefs are shared throughout all Christian faiths: The existence of god and the special role of Jesus, however it is formulated. But the existence of god stands in essence merely for the message of all religious thinking; that the world is a meaningful whole. And there can be no doubt that Jesus was a special person already from the historical perspective, looking at the impact he had on the world.

I therefore have little doubt that believers (and of course not only the Christian ones) could again re-new their faith in the form of a religion for the 21st century: With a reasonably distanced view on history and ritus, with a mythos adjusted for what we know about our world (still leaving plenty of room for god), and an ethos that promotes as ever those eternal truth that first of all we should love others like we love ourselves, or maybe even better in proportion to how much in need of love they are. In A-world, to not let religion grow, would mean to abandon it.

Chapter 40

AI and the matrix – To the high programmers of the alpha complex

At the very last we return to where we started: In the very beginning of this book, while arguing against the view that human thinking is not more than the computation of information, I questioned the ’intelligence’ of current artificial intelligence (AI). Having mapped out things in somewhat greater detail, we are finally ready to return to the underlying question, of whether maybe future AI can make up for this limitation.

So let’s try to take a look at the future of humanity in the light of our previous discussion: In A-world, ’real’ intelligence is bound to agents, but realized only via embodiment. Thus no machine can become intelligent in this sense. But more or less bare agents are not life, and could maybe in the future be manipulated like matter. We would then be able to build ’hybrid’ material/non-material, non-biological organisms, which could show real intelligence.

The hurdles would be great, but could maybe be overcome step by step: Once we would understand the material/non-material links in the brain, we could think of building non-biological ’hardware’ for such links, which would then almost automatically be taken over by agents. Depending on what material mechanism we allow those material links to have access to, the existence of such hybrid systems could be limited to no more than a ’creative’ computing machine, or be as open as for a new form of intelligent life.

The hardest part I assume would be to design the equivalent of human development, i.e. the coupled growth of both the material and non-material machinery. Such growth is necessary to actually build up a mind, which can not be created simply at once and in full, because of the very limited material possibilities to structure the non-material.

Once we would be there, the implications would be wide-ranging: Having the option to at least in principle shift our minds to new hardware, the idea of constructing a 'matrix' to live in would surely come up.

In A-world, such a shift would not mean that we would still have 'real' bodies and only let our minds wander through some computing machine. The all-encompassing re-bundling of basic bundles of qualia involved would instead mean to add a new layer between us and material consistency.

Our bodies would change (probably dramatically), but we would still have them, only that now they would be driven by a different machinery. There would be nothing 'unnatural' about this. We would have to image such a matrix to be much more glamorous and fun, but at the same time able to minimize all sorts of problems: Ecological and social problems would be minimized, certain forms of discrimination and abuse could be prevented by design.

We would surely still implement some form of material consistency, but I doubt that we would not find some consistent extension of reality to be possible. We could for instance have such a magic-like control over our own bodies, that having specific bodily features would become rather a fashion-type thing, than a source of discrimination and mental health issues. We could even think about extending our self in ways much beyond how we seem to be able to do it today.

Overall, the matrix could enable a more grown-up population, but would also already require such a population at the time of it's design and setup: Quite the opposite of all of the above could also be implemented by tyrants, and we could equally well fight over matrix resources, if we are greedy enough.

The distinction between humans and AI would be blurred, depending on how artificial systems would be designed. And as likely as humans could run the matrix, other forms of intelligence could as well. They would have no less right to do so than us, and would most likely be more open to share.

Such growth through technological means would be much easier, safer and potent than enforced biological evolution, as the later is not able to 'optimize' the underlying physical laws. But the material world defines our identity (though sometimes badly) and change would better be well-thought through, especially as there might not be a way back, if some new developments can not be back-transferred anymore.

Our strong material consistency requirements suggest, that we are not in a matrix already, but would we recognize alien life, if it has made the move already? There could be a (on galactic scales) rather short time span for civilizations between being able to sent signals into outer space and being able to move into a matrix. So now we have entered fictional science in full. If you enjoyed things up to here, you might enjoy a little tractatus at this point.

Chapter 41

Tractatus – Be with me (salt anybody?)

1. The mind/matter gap is a nexus of core obstacles for the further unification of the intellectual enterprise.

1.2 Qualia, mental causation and scepticism are hard to reconcile with our current scientific world-view.
1.2.1 The mind part suggests objective meaning, mental causation and a principally holistic view giving rise to scepticism.
1.2.2. The matter part suggests information, material causation with quantized interactions at the bottom and relativity via spacetime at the top, as well as a 'marginally holistic' view, well-suited for reductionist science.

1.3 There are nevertheless a number of arguments for a possible reconciliation.
1.3.1 The non-contradictory/consistent mental is based on a close relationship between meaning & information, mental causation & materialism and a limited holism.
1.3.2 The development and implementation of our materialistic theories is indirectly, but strongly based on the mental, e.g, meaning, creativity, concepts and mathematical entities like numbers etc.
1.3.3 A number of physical observations point to a more direct connection between mind and matter, e.g. the measurement problem in Quantum Theory.
1.3.4 Philosophy suggests a necessary 'Kantification' of physics.

1.4 The reconciled view would allow us to go from both materialism and the

mental towards the full theory, but with our limited knowledge, we have to start from either materialism or the mental, which takes for us the form of the question of what grounds what.
1.4.1 We have not found a stringent and useful model to account for qualia starting from basic material parts distributed in spacetime, without simply denying their main characteristics.
1.4.2 Current scientific models are well established, but show a lack of possibilities for understanding and further unification of their foundations.
1.4.3 I find it thus more constructive to decide the question of what grounds what in favor of the mental, i.e. to invert the mind/matter problem as a way towards monism.
1.4.4 No ontological claims need to be associated with this, structural claims are just fine.

1.5 Inverting the mind/matter problem could be not only a philosophically, but also scientifically attractive hypothesis.
1.5.1 Bridging the mind/matter gap this way would make sense, if beyond giving back the mental it's place in the world, it could account for some or all of the foundations and dimensionless constants of current physics: The arrow of time, the dimensionality of space, the 'phenomenological' content of Quantum Field Theory, General Relativity and Thermodynamics, as well as the objects and parameters of the standard models for cosmology and particle physics.
1.5.2. Inverting the mind/matter problem is not illegitimate: Science has a track record, but it's less systematic version 'common sense' even more so. Technology is indebted to the latter at least as much as the former; we develop it based on rational consistency, not from knowing physical substance.
1.5.3 Inverting the mind/matter problem is not obviously futile (and at least for me quite a delightful intellectual venture too).
1.5.4. If successful, such a 're-enlightenment' could help to save critical thinking against populism, a feat for which abandoning materialism seems a reasonable price.

1.6 The biggest problem is to recover the 'phenomenological' content of physics, i.e. the sum of theory-laden, but ontology-tolerant observational facts of physics.
1.6.1 Science itself suggests, but requires no specific ontology. To take the currently best suggestions is considered even within science as a working hypothesis only, with the hope of establishing a more proper ontology later

on, currently for instance via strings.
1.6.2 We do not have to fit the 'physical' content of science in the sense of the current mathematical models or the empirical content of 'facts' within the current model, but only the phenomenological content in the sense above.
1.6.3 To confuse the physical and mathematical content seems to me the most dangerous, but most prevailing error, leading to a large number of misleading interpretations, e.g. virtual particles for attractive coulomb interactions in QFT etc.
1.6.4 Properly inverting the mind/matter problem should not lead to subjective idealism, but monism entailing both the mental and physical world.

1.7 The whole issues is not a new problem. The documented 'intellectual' mind/matter gap stems back to the beginning of philosophy ...
1.7.1 Already Socratic scepticism established a strong non-congruence between mind and matter. Probably not Plato himself, but the 'physics of qualities' at that time were in the sense discussed here monist models. Plato kept Socrates non-congruence as dualism and his time did thus not lay the foundations for a more mature monist model of physics.
1.7.2 The successes of Descartes and of materialist physics by the Bacon, Galileo, the great astronomers, Newton and their followers firmly established the mind matter gap, but Locke, Leibniz and others were aware of the problems; cohesion, motion, long-range forces and sensations remained the philosophical riddles that they were for Locke.
1.7.3 Subjective idealism, the thesis of the at best inter-subjective mental to ground the material, does not seem to allow for a mathematically consistent unification with physical science.
1.7.4 Gödel, Quine, Wittgenstein, as well as Einstein and quantum theoreticians have extended our knowledge to a state, where both from the philosophical as well as the physical viewpoint, dualism seems unsatisfying.

1.8 ... but to unite or invert the mind matter problem was not possible in the past.
1.8.1 For very early attempts, e.g. Plato, it was unnecessary and would have been basically impossible to investigate. More modern approaches, e.g. Leibniz, were still limited by the physical knowledge of their time.
1.8.2 Nowadays the situation is inverted, i.e. the highly developed stage of current physics makes it hard to go back before the related materialist philosophy and still produce useful results.
1.8.3 I nevertheless argue that science has reached a stage where it is possible

and probably even instructive to re-evaluate the idea not only from a philosophical, but also from a scientific point of view.
1.8.4 What we are looking for is a modern physics of qualities, with the constants of modern physics as parameters of such a new 'natural philosophy'. (We will have to go back before Plato and do baby steps from there, as we don't stand on the shoulders of giants anymore!)

1.9 The entities of a meta-theory are not necessarily logically deducible from the underlying theories, so that we have to speculate to find the best fit with a critical examination of our experiences. (This is in some sense unsatisfying, but still fun!)
1.9.1 It means that after a proper investigation of science and philosophy, and before asking the question what the core scientific problems are, we have to specify a (necessarily speculative) model of what exactly it is, that we like to posit as real.
1.9.2 The ontological status of these 'real' or structurally real posits is open to debate.
1.9.3 As for any model in science, these models are purely speculative up to the point where we can make experiments to test them.
1.9.4 The questions which we have to ask ourselves when setting up such a model are quite general and of some less speculative value.

1.10. The type of models proposed here
1.10.1 is based on simple sets of principles,
1.10.2 fits (at least on a conceptual level) to modern science,
1.10.3 and allows not only for qualia and mental causation (by design),
1.10.4 but could help with other foundational issues in philosophy, physics as well as neuroscience.

1.11 There are core 'insights' (actually assumptions) on which these models are build:
1.11.1 Unified building blocks have to be compatible with the non-material, thus making space a derivative feature of reality.
1.11.2 True agency has to be a basic building block, but it can then become a central explanatory device also for the foundations of our physical world (as natural laws are a feature of the material world to be explained, rather than an explanatory element for a unified view).
1.11.3 The power of science lies in it's focus on information, not meaning; in

counting relations instead of attempting the impossible.
1.11.4 The world is probably much more colorful and kind.

Chapter 42

Closing – The common sense to keep quiet about the other thousand insane thoughts

Starting from the from my point of view most important problems for our current scientific world-view, namely qualia and mental causation, I have tried to map out how we could rethink the cornerstones of our materialistic world-view; atoms, thoughts and words.

A-world describes the 'atoms', or more accurately the particles, the quantized excitations, which we believe to be the basic building blocks of our material world, as what we find when trying to 'count' the relations between bundled qualia. A-world describes thoughts as (bundles of) qualia we perceive, much in the way we have sensory experiences. A-world describes words as linking the material and non-material, thereby providing us with our most powerful tool.

The beauty of A-world is: It basically says yes to all of it, it takes science, philosophy and our everyday human experience at face value, and it could help with a broad range of open questions, even those we usually don't ask, like why causality?

A-world proves nothing, but makes a point. We wanted qualia and mental causation and put qualia and agents in, we wanted to keep science and adjusted the build-up so that things could fit. As naive as this looks, I think that's very often how new scientific paradigms develop; by taking things at face value – think of Newton's view of matter or Einstein's take on quanta and the speed of light. The point made is, that the challenge of A-world is open: It's not unlikely that no such new model can be constructed, but we certainly haven't really tried yet.

If successful, the implications would radiate out: A-world could increase trust in science, as it makes room for the irrational, but also puts it in place, with a material world that is not a surface, but a basis for the non-material. At the same time, it would change the way we see our world: A-world posits a rich 'machinery' behind behavior and psychological phenomena, including the field of somatic disorders and mental health. It allows for social processes at an existential level, and also accommodates irrationality in social and psychological contexts. A-world thereby allows not only for science, but also the non-derivative existence of ethics and art, thereby extending our technological rationality (much in the sense of Jürgen Habermas) with esthetical and ethical perspectives. Finally, common sense is recovered, without 'over-reaching' prescriptions by physics or neuroscience (e.g. concerning the existence of free will).

This book is obviously neither proper science nor philosophy, but at best pre-scientific, in the sense that one needs to ruminate on problems alongside the true 'business' of science, before one can start to address them. I do hope that it will not be called pseudo-scientific or esoteric, because it nevertheless tries to adhere to scientific and philosophical rationality where possible: The book does not question the correctness of any established scientific theory in it's field – quite the opposite; it tries to make new terrain scientifically understandable. It does not lend to esoteric or magical thinking, or to racism, nationalism, sexism and such – if you think so, please read it again more carefully.

Religion, the renaissance, as well as the enlightenment did all not lose steam because of scepticism only, but because the envisioned hopeful ways forward were step by step discredited. Religion was probably easier to discredit than the enlightenment, because of it's strong focus on the past and the religious institutions' secular strive to keep power, but even the enlightenment had to give in. To re-enlight, we are now badly in need for a new Newton. But I have no doubt that once Ms Newton steps into the light, paradigm change will be possible, with young people searching for growth and the older ones (like me) dying out. So let's keep our eyes wide open for her (or they) – and let's get out of her new ways if we can't lend a hand.