Everything is Possible:

the No-Limits Working Hypothesis

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Preface

Central in my whole life have been two ongoing adventures, both of which I embarked on in my high school days. Each of these filled me with a sense of awe, more than anything else I had experienced. And after half a century of groping for ways to connect the two, I now finally feel that I may have something to say that might be of interest to others.

One adventure is the study of the world from the largest to the smallest scales: in the lab, in the field, in computer simulations and thought experiments. The other adventure is the study of the mind from the ordinary way of functioning to deeper levels of awareness: in daily waking and dreaming practice, in the lab of everyday life, and in retreats.

In both cases what transformed the adventures into sustained and systematic explorations was the sharing with my peers: in a two-way flow with those I could communicate with and in a one-way with those whose books I read. The current book is influenced by all those interactions, far over a hundred thousand if I count all those moments that I was struck by what someone said, wrote or did. And I feel that these adventures are very much ongoing, every day afresh: what I am reporting here is very much a work in progress.

My scientific research has ranged over many different disciplines. With a PhD in particle physics and astrophysics, I collaborated with geologists and paleontologists in studying mass extinctions, with computer scientists in developing novel scientific software environments, and later with chemists and biologists to study the origins of life, to mention just a few topics. I am grateful for having the freedom to engage in so many different areas of research, in my role as the Head of the Program in Interdisciplinary Studies at the Institute for Advanced Study in Princeton, in addition to my position there as Professor in Astrophysics.

In my study of the mind I have emulated the model of physics, where theory and experiment go hand in hand. For

theory I have mainly studied the western philosophy of phenomenology and the eastern philosophy of Buddhism and other Asian traditions. On the experiential side I have practiced a wide range of forms of meditation. Through a combination of reflection and meditation, both feeding upon each other, I have to some degree been able to make a living contact with the vast store of knowledge and wisdom in Asian as well as European contemplative traditions.

I expect that the methodology of science, the use of open peer review, in which theory and experiment go hand in hand and keep each other honest, can be a source of inspiration for contemplation. And I also expect that contemplation can inspire cognitive science to develop a broader understanding of knowing. Astronomy would not have gotten off the ground without the database of astrology, and chemistry would have had a very slow start without the database of alchemy. Similarly, without any value judgment and with all due respect, traditions such as Hinduism, Buddhism, Taoism, as well as various forms of mysticism, can provide us with rich databases built up through their study of the mind to speed up our cognitive investigations in a wider setting than is done today.

It is the awe that I have experienced in my adventures in science and contemplation that I want to share here. In the tradition of books published in the seventies, I could have given it a title like "The Joy of Science and Contemplation", or "Zen and The Art of Science and Contemplation". May the reader share in the artful joy of exploration!

For me, it has been a pleasure to write this book. But most importantly, if this book can inspire a single high school student to focus on the central problem of the role of the subject with the tenacity it takes to discover a whole new approach to the study of nature, it will have been worth the fifty years of study that I put in before I could write it.

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Part I. Starting at the Science Side

Chapter 1. A Working Hypothesis

The secret of science, its most active ingredient, is the use of a working hypothesis. After some initial data gathering, and some guessing of how it all hangs together, a scientist formulates a working hypothesis.

It is called a hypothesis because no judgment is made as to whether the guess is right or wrong. The whole point of formulating a hypothesis is to come up with an interesting idea that can then be tested by working with it.

What is called 'working' here means engaging in the work that scientists do: gathering new evidence through experiments or observations and interpreting the evidence to see whether it may support or contradict the hypothesis.

The working hypothesis that is the title of this book is "everything is possible." In other words, nothing is guaranteed and nothing is excluded. This may sound rather abstract, so let us look at some examples.

imposed restrictions to the possible

In a game like chess there are rules. A pawn can never move backwards. However, the wooden piece that stands in for a pawn can easily be picked up and moved to a square behind its original position. It is only within the framework of playing a game of chess that there are rigid restrictions to the ways in which it can change position.

Well, you could say, chess is just a game. Of course we can violate the rules of a game. But what about the real world, what about the rules of physics? Do they not imply absolute restrictions?

But before conceding that there do seem to be absolute limits on what is possible, let us look more carefully. When Newton formulated his laws of classical mechanics, they indeed seemed like absolute laws that could not be broken. Nature itself had imposed them, and Newton happened to be the first human being that uncovered them, or so the story went for more than two hundred years.

violating perceived restrictions to the possible

Early in the twentieth century, it became clear that absolute space and absolute time, as postulated by Newton, were not absolute at all. While very good approximations, they were only that, approximations that could be violated.

Imagine a very heavy object that seems impossible to lift. The height and the width of this object, for all practical purposes seem to be fixed. But with the invention of better lifting technology this object can be tilted, changing both its height and width. After all, height and width are projections, like shadows on a wall and on a floor, and not intrinsic to the object at hand. A low and wide table will look tall and thin when put on edge.

Similarly, durations in time and distances in space can to a large extent be transformed into each other by 'tilting' them in spacetime, as Einstein discovered when he formulated his special theory of relativity. As a result, at very high speeds, close to the speed of light, time seems to flow considerably more slowly than is experienced by a static observer. Similarly, distances seem to contract.

There were more dramatic consequences to his theory: he realized that matter and energy can be transformed into each other as well. As a consequence, a few pounds of enriched uranium or plutonium can destroy a large city when used in a nuclear bomb; or it can keep the lights on in the city for many days when used in a nuclear reactor. This is one of the most powerful examples of something that was thought to be impossible, until it was shown to be possible.

questioning imagined restrictions to the possible

When children grow up, they learn what is and is not possible, under normal circumstances. They form pictures and stories in their minds about the nature of physical reality as well as the nature of the social reality they find themselves in. And those stories that are confirmed time and again tend to harden and become treated as absolute, as "the way things are."

We all know how hard it is to change someone's deeply held belief, including those that we ourselves hold near and dear. Not only that, even questioning what are perceived as "innate rights", such as the right to bear arms, can get one into hot water.

One of the most fundamental restrictions that we learn as infants is the difference between self and other. And once we are three years old, having learned to talk and make our own wishes and concerns known, the distinction between me and you seems absolute. I can look through my eyes but not through yours, know my thoughts but not yours. That seems like a clear violation of the working hypothesis that everything is possible.

But before jumping to the conclusion that our working hypothesis is false, let us investigate how reliable our convictions in these matters really are. When we are dreaming, for example, we are equally convinced that our dream body is exclusively ours and that other bodies in the dream belong to others. Yet when we wake up, we realize that the whole dream was ours, created in our own mind.

Even without falling asleep and dreaming, it turns out to be remarkably easy to find a lot more playing room around and away from the identities that we normally cling to. Let me give a few examples here, as well as at the end of each chapter following this one.

playing with subject/object roles

Here is a simple experiment that can help us to explore the nature of our view of ourselves in the world around us. Choose a single object in your field of vision. It could be any object: a teacup, a tree, anything you like. As a first step, just spend some time looking at the object. Notice your relationship with whatever you have chosen, how you are the active subject watching a passive object.

After a little while, try to see whether you can gently reverse the relationship by letting the object look at you, rather than you looking at the object. Don't try to think or otherwise analyze whether or not this makes sense. Just try it and see what happens.

This is an open-ended exploration. Perhaps your sense of presence will change to some extent, physically and/or mentally. You may feel more relaxed, overall or in particular areas of your body. You may feel some puzzlement or surprise, once you allow yourself to be seen in an unusual way. Or none of the above!

Interestingly, it turns out that different people can have quite different reactions to this simple experiment, and also the same person may report different outcomes on different days or in different situations. It may be fun and illuminating to ask one or more friends to do this experiment with you and see what they will report.

The wide variety of outcomes that you will likely hear does not mean that this is an invalid experiment. On the contrary, it signifies a rich doorway into an exploration of some of our most deeply rooted ways of engaging with the world -- something we learned between ages one and two, and which we may never have questioned in any directly experiential way since.

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Chapter 2. The No-Limits Working Hypothesis

In order to test our working hypothesis that everything is possible, it is convenient to rephrase it in negative form. It then becomes the no-limits working hypothesis, which postulates that there are no limits to what is possible. If we would ever find a convincing example of an absolute limit, that would then disprove our working hypothesis.

We have already seen that there are many relative limits, limits with respect to a given framework. If you accept the rules of a game, then there are things you are not allowed to do, according to the agreements you have made. And if you accept a specific theory of physics as providing a description of reality, then that theory will tell you that there are real limits to what is possible -- until a more accurate theory comes along which is likely to tell you that those limits can be transcended in various ways.

Even if we believe that science will ultimately chart all of reality, giving us a precise description of all that is ever possible, that belief will not help us in determining right now what is possible. Science is still making significant progress year by year, and even within our lifetime we have seen many plausible scientific theories being superseded by more accurate ones that circumvented the limitations postulated by slightly older theories.

a few examples

One example is the belief, only a couple decades ago, that the human genome would provide a kind of blueprint for the human body. In other words, your genetic makeup would put strong limits on how your body could develop, just like a blueprint determines what a building will look like. But before long, the discovery of widespread epigenetic effects showed how organisms could be changed dramatically through modification of gene expression rather than through an alteration of the genetic code itself.

Another example is the discovery of quantum theory about a century ago. Until then, there was a firm belief among scientists that the cornerstone of scientific experimentation was the repeatability of experiments. Only if different people, following the same instructions can report the same outcomes would an experiment be deemed to yield truly objective results. Or so the story went. But plausible as it seemed at the time, it was only a story as it turned out. Even though that belief reigned supreme for about two and a half centuries, from the late seventeenth to the early twentieth century, it was only an approximation.

On small enough scales, repeating an experiment is not guaranteed to give the same result. This is the gist of the quantum mechanical uncertainty principle, discovered in 1927, which tells us that there is an intrinsic uncertainty that determines the outcome of measurements in a random way. While the uncertainty is small under every-day macroscopic circumstances, it was a discovery that shook the foundations of physics. And in doing so, it reminded us that every scientific theory is an approximation, often a very good approximation relative to a certain domain, but potentially failing spectacularly outside its original domain of applicability.

Perhaps surprisingly, both games and scientific theories present us with limits that are only relative to particular frameworks.

story telling

What the implications of the rules of a game and the predictions of a scientific theory have in common is that they are both stories based on presuppositions. We do not have any direct access to the underlying nature of reality beyond what our empirical observations combined with our learned inferences show us, whether in daily life or in scientific investigations. We use language and concepts in order to capture the essence of our experiences, and in turn we play with the concepts until we are able to construct impressive

edifices that seem to explain and even predict what we see happening around us. We then start to firmly believe in those.

We are normally not aware of the many steps that are leading up to the point when our firm beliefs about the nature of reality are fully formed, whether it is our physical reality or our cultural reality. Starting with directly given experiences, combined with our ability to remember, we have learned to form concepts about regularities. That in turn has led us at a young age to develop theories of how things work in the world, and of how others see the world. From a budding belief system sprouting up around those theories, then emerged a finally hardened grand narrative about "the way reality is." And through this trajectory, once a child becomes an adult, its views tend to lose their original freshness and flexibility.

And among the stories that we tell ourselves and each other, one of the most central narratives is the one that puts each of us at the center of our experienced universe, as a single subject, surrounded by countless objects. And while some of those objects may be subjects themselves, such as other humans or cats in their relation to us, they function as objects. We started to explore this most basic subject/object relationship in the previous chapter. Let us follow that exploration a bit further.

playing more with subject/object relationships

After repeating the simple subject/object reversal with a specific object as we did earlier, it will be interesting to do the same type of reversal but with a whole collection of objects.

Again take a comfortable position, sitting or standing, and just look in front of you at the whole visual scene that presents itself. Take a couple minutes to look at the whole scene and remind yourself of the role that you normally play,

as the single subject watching everything around you, as a collection of objects seen by you.

After a while, try to reverse that relationship. But this time, let everything that presents itself in your field of vision, look at you, all at the same time. What happens when you make this reversal? If you do it a few times, in how far is the shift in your experiences each time similar or different? And what about different scenes you may be looking at? Does a different scene tend to evoke different reactions?

As before, it will be interesting to compare notes with friends who are willing to embark on the same kind of explorations. Whether you do this together with others, or later hear their descriptions of their experiences, you are likely to be surprised by how different those are from what you are reporting yourself. Once you step off the beaten path of your standard way of functioning in the world, there are countless ways of experiencing differently.

But even apart from the details of the ways in which you can experience these reversals, the very fact that you have such an unexpected flexibility in playing your role as the central subject in your world, already gives you a first hint as to how overrated received limits are in our ways of looking at the world.

This is only the beginning; we will explore quite a few progressively more impressive shifts in how free we really are in our ways of engaging with the world.

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Chapter 3. Patterns in the History of Science

Looking at the history of science over the last four centuries since Galileo, what jumps out is the amazing success of the attempts at unification of our theories.

Two thousand years before modern science took off in the seventeenth century, Aristotle had already unified the descriptions of the natural world from a phenomenological point of view. Without trying to speculate about deeper underlying theories, he gave accurate accounts of his empirical observations in many areas of science. And even though empirical knowledge of the natural world accumulated during the next two millennia, theory did not make much further qualitative progress.

Aristotle's barrier

One major sticking point in Aristotle's descriptive unification was the fact that he assumed a strict barrier between the realm below the Moon and the realm above the Moon. Here on Earth everything is constantly in flux, while in the heavenly realm of Sun, stars and planets, everything occurs in peaceful regularity. In contrast to the Heavens, any type of motion on Earth ultimately runs out of steam, whether rain falling on the earth, rivers flowing to the ocean, projectiles being thrown at an enemy army, or animals moving around until they die.

From a descriptive point of view, the Aristotelian model is straightforward, economical, and corresponds to the phenomena observed. But as often happens in science, a simple fit to what meets the eye can easily become a barrier to deeper understanding. It took two thousand years until Copernicus started to breach Aristotle's barrier, an enterprise that culminated with Newton's discovery of universal gravity: the way an apple falls to the ground is described by the very same Newtonian equation of gravity as the way the Moon falls around the Earth.

In the few centuries since Newton, once Aristotle's barrier was taken down, in rapid succession the new program of unification spread through all scientific disciplines. In this relatively short time seemingly unrelated aspects of the world were discovered to be intimately related in ways nobody had ever dreamt of. But let us start with a look at much earlier unified theories, using a simple example easily at hand: ice melting and water freezing.

a unified theory of water and ice

We all know that water and ice can transform into each other. Without any change in its substance or constituents, heating a block of ice makes it melt and subsequent cooling of water turns it back into ice again. The properties of water and ice could hardly be more different: water flows and can take the shape of any vessel it is poured in, while ice is rigid. You can walk on ice, and build an igloo out of it, while you can drown in water, and guide it for irrigation.

Speculations as to why this happens have been made in many cultures. The Greeks, for example, considered these transitions to be a play of four different elements, fire, air, water, and earth. Some Greek philosophers postulated the existence of very small indivisible particles, called atoms. Others, like Aristotle considered matter to be continuous.

However, this all remained speculation until the development of quantitative theories at atoms in the 19th century and finally direct observational evidence of the existence of atoms early in the 20th century. It would take until the late 20th century for a mathematically precise theory of phase transitions to be developed, leading finally to a satisfactory unified theory of water and ice!

a shift toward mechanical explanations

For us it is hard to imagine what it would be like to live in a world in which one has no idea of the existence of atoms

and molecules as the constituents of matter, or the existence of cells as constituents of tissues of plants and animals. All those are explanations we grow up with, based on essential details that are invisible to the naked eye. Even harder it is to imagine what it must have been like to look at the Sun, the Moon, planets and stars, while having no idea at all of what those various lights in the sky were doing there and what they were made of.

Especially for the existence of the Sun, so central for everything in life, to have only a just-so story based on unverified and seemingly arbitrary opinions, handed down as beliefs, strikes us now as hard to imagine. We have been so successful in coming up with explanations based on scientific theories and experiments, that our eyes are drawn to all that we can now measure, as the ever growing body of science. And as a result, we tend to ignore what isn't (yet) part of what science has learned to investigate.

As an example, psychological states such as depression in adults or hyper-active behavior in children are increasingly projected onto chemical causes and treated with chemical drugs, with relatively little attempt to develop new scientific frameworks that are based on other paradigms, a topic that we will later return to. But for now, let us follow the success story of the shift to (quantum) mechanical explanations, currently forming the basis of physics, chemistry and biology.

increasingly unified theories

In the nineteenth century, in physics Maxwell showed how electricity and magnetism, two rather different phenomena, can be seen as two aspects of one and the same underlying theory, electromagnetism. Around the same time, in biology Darwin showed that the huge diversity of living organisms can be viewed as stemming from a single unified theory of evolution.

In the twentieth century, new unification discoveries took on more and more dramatic forms. Einstein showed how time and space could be described as part of a unified description of spacetime. And as a spin-off of his special theory of relativity, it became clear that mass and energy could be transformed into each other.

A couple decades later, Heisenberg, Schrödinger and others developed quantum mechanics, which showed how the most accurate and detailed study of matter leads us to conclude that actuality and potentiality are unified and cannot be considered in isolation. Any physical system exists in a mysterious balance between being purely potential and purely actual.

According to the Copenhagen interpretation, for example, any measurement forces some aspects of potentiality to become actual, while forcing some other aspects of what had been actual to become potential. The notion of entanglement, the "spooky action at a distance" that is now a topic of active research in quantum computing, forms a spectacular example. Other interpretations show different light on these conundrums, but it is clear that the actuality/potentiality divide is far more subtle in quantum mechanics than it was in classical mechanics.

In biology, the discovery of DNA as a shared code for storing genetic information in any living cell on Earth revealed a uniform information processing system. In computer science, the discovery of the universality of the Turing machine was another surprising success of the drive to further unification. Many other examples can be found.

Aristotle posited different laws of nature for the realms beyond and below the moon: eternal motion above, and stagnation below. Who would have thought that abandoning that distinction, in the unification that was accomplished in only a couple generations from Galileo to Newton, would have led to this plethora of increasingly shocking steps of unification in our knowledge of just about everything in nature?

extending the explorations of subject/object reversal

Continuing from our previous playful adventures, in which we reversed roles of subject and object, letting ourselves play object being looked at by everything in our field of vision, we can now widen our investigation even further. How about letting ourselves be seen by everything around us, not only in front of us, but next to us and behind us, above and below us?

At first, this may generate an odd feeling of being looked at by objects behind our back, and it will be interesting to note how this change of mindset can generate changes in the way we perceive not only our feelings, but even physical sensations, for example in our back. As before, trying this a few times under different circumstances and with some different friends will enrich our sampling of different outcomes of these experiments.

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Chapter 4. Expected Patterns in the Future of Science

At the end of high school, when I had to decide my major field of study in college, my main interest was, simply speaking, the study of the nature of reality. Lacking a department of reality studies, I considered astrophysics, as the study of the material Universe; philosophy, as a more abstract study of reality; and non-European languages, given how different languages can give rise to rather different ways of experiencing reality.

I finally chose astrophysics, largely because the other two options seemed easier to undertake in my spare time. That turned out to be a good choice: I finished my PhD in astrophysics in my twenties, I learned Japanese in my thirties, and I extensively studied phenomenology as for me the most interesting branch of philosophy in my forties.

the most conservative extrapolation of science

What was the most frustrating during my study of astrophysics was the fact that I seemed to be alone in my expectation of what physics was headed for. Not only did I not find anybody else with a burning desire to look for a department of reality studies, even my most conservative estimate of future discoveries in physics were seen by my class mates and teachers alike as lying totally outside any sensible use of the word physics.

My thinking went as follows. The main reason to study (astro)physics was in order to be on the forefront during the next big discovery that would happen during my lifetime, in the half century following my entry into the academic world. And even better, I loved to make some small contribution myself to paving the way toward that kind of big step forwards.

Curious as to the nature of that next discovery, I wondered what the puzzle would be to which it would produce an unexpected answer. The only thing I had to go on was the list of big discoveries of the past few centuries in physics. Was there a clear pattern that could be extrapolated? If so, doing so would be the most conservative way to predict progress in science.

And there was such a pattern! Unmistakably. It was the series of unifications of our theories of the nature of reality, each next one being more profound, in unifying ever more seemingly different aspects of the world than before, as we saw in the previous chapter. From the unification of our theories of electricity and magnetism, to theories of space and time, and of matter and energy, and in quantum mechanics of the potentiality and actuality in material reality, what could possibly be yet more profound and amazing?

toward a unification of theories of matter and mind

For me, in high school at age 17 plotting my future career, the answer was clear. The only thing I could think of as being even more revolutionary than the unifications already presented in general relativity theory and quantum mechanics, would be the unification of theories of matter and mind. What else could it possibly be?

Of course it was a guess, but it seemed, to me at least, to be by far the best guess possible. I only saw two believable outcomes. Either the spate of unifications of the last four centuries, from unifying the theories of the sublunar and supralunar worlds, via Darwin, Maxwell and Einstein to the spectacular discovery of quantum theory, would suddenly come to a screeching halt or it would continue. It seemed so clear to me that the next even more stunning unification would have to entail mind and matter.

I definitely wanted to bet on the latter of the two options. It seemed extremely unnatural and pessimistic to think that after a dozen major and many more minor

unifications, suddenly science would run out of steam, leaving the last big challenge unsolved. So I happily entered college by taking a combined major in theoretical physics and astrophysics, to be prepared at least from the matter side, to see what would offer itself.

In the end I did my graduate research also in both areas, of the smallest particles and the largest scales of the universe, writing a PhD thesis that combined both theoretical physics and astrophysics. Part of my thesis naturally focused on the theory of the Big Bang, while other parts included detailed calculations of tidal interactions between stars, the results of which turned out to be quite important for the study of exoplanets a couple decades later. I greatly enjoyed my studies, as well as my postdoctoral years of research, after which I happily accepted an offer of a position of full professor at the Institute for Advanced Study in Princeton at age 32.

a very big surprise

What I did not enjoy very much, was the very big surprise I encountered immediately in my freshman year, which I already alluded to above. Just about nobody took my conservative extrapolation seriously. To my astonishment, the general view was that all we could hope for was a unification of general relativity and quantum mechanics, and then physics would be completed. I saw that as the most pessimistic possibility, that physics would come to an end by tying up the obvious loose ends that were left lying around at the time, and not much more.

Not that doing so wasn't going to be exciting in itself. In fact, for my Master's thesis, I took Stephen Hawking's discovery of the evaporation of black holes, two years earlier, and applied that to thought experiments. Putting an electrically charged black hole in a box in my imagination, I could perform standard thermodynamic experiments. Varying the energy or density or temperature of the radiation in the box or the charge of the black hole, I discovered that

the system could undergo phase transitions, including even a critical point at the end of a phase equilibrium curve.

In short, for a given charge and total energy in the box, there would often be two stable solutions, one with most of the mass in the black hole, and a radiation field filling the box at relatively low temperature, and one with much less mass in the black hole, and a radiation field of far higher temperature. In my virtual simulations of such a system, I enjoyed seeing the system jump from one phase to the other across the critical line.

Some of my PhD research also connected the largest and the smallest, using the theory of the Big Bang to put limits on the masses of neutrinos. I was one of the first people to do so. Independently, one of my heroes, Steven Weinberg, from whose book I had learned general relativity, together with Ben Lee came to the same conclusion at the same time. I heard about their work after my thesis advisor, Tini Veltman, who later would receive a Nobel prize together with his former student Gerard 't Hooft, had sent Weinberg a preprint of my results. Weinberg wrote me a short hand-written letter, in the days before email, telling me that it was clear that they and I had reached the same conclusion. Receiving that letter was one of the most encouraging highlights in my student life.

So yes, definitely, working shoulder to shoulder with some of the leading lights in physics to work towards finding a unified theory of general relativity and quantum mechanics was really exciting: it was one of the most exciting things I could imagine myself doing but not the most exciting.

the most exciting research project

What I considered by far the most exciting research project was to help lay the ground for a unification of mind and matter as the next big leap in physics. Not finding any response or even interest in the academic world of the time half a century ago, I decided to study the mind in my free

time as a very serious hobby. As I will describe in more detail later, while still in high school, I found a book about meditation and recognized it as advocating a very similar approach as science. The main difference was to use the mind as a lab instead of the material world.

Excited about the chance to study mind and matter in parallel, albeit in completely different milieus, I embarked on a long journey in which I studied contemplative traditions from Medieval Christianity to Sufism, Hinduism, Buddhism, Taoism, and others. Initially I did so mostly by reading, and exploring meditative practices by myself but soon found communities and teachers associated with various traditions, which all were a great help in getting a real sense of what living traditions can have to offer, as well as the surprising similarities between their core pursuits.

further explorations of subject/object reversal

To continue the series of explorations, offered at the end of each chapter so far, consider switching from the visual reversals we have been working with, to auditory reversals. Instead of listening to the sound of a bird, let the sound of the birdsong listen to you. Alternatively, let the bird listen to you. In both cases you are the object of the listening, and either the birdsong or the bird takes on the subject role.

Note that we could have made the same distinction in the visual versions of the first three chapters. Instead of letting a tree see me, we could let the image of a tree see me. However, it would require some training to become consciously aware of the separate experience of an image of a tree, as different from the experience of seeing the tree. Somehow it is easier, and feels more natural, to distinguish a birdsong from the bird that is singing. It is probably related to our visual sense dominating over our auditory sense, hence the unconscious identification of tree that is seen with the image presented to us of the seen tree.

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Chapter 5. Preparing the Way

Given the environment that I encountered, hostile to the idea of searching for a unification of theories of matter and mind, I realized that I had a choice. Either I would strike out on my own, trying to guess at the structure of such a unified theory, or I would play a more modest role, namely to prepare the way for such a future development.

In order to decide which approach would be the most appropriate, I again took the most conservative stance I could think of, by looking back at the way other great breakthroughs had been made in science. Reading about the history of science, and taking some undergraduate classes in that area, it become abundantly clear to me that there was no point in just guessing. Even in the unlikely case that you would guess right, you would not really advance science if the time was not yet right to ground your guesses in the science of the day. At best you would become an obscure footnote in the history of science, as an isolated forerunner.

It seemed much better to be a catalyst for further progress, rather than shooting in the dark. Having experienced first-hand the various ways in which people chose not to believe my arguments for a future unification of matter and mind, I began to see how and why they just could not believe me, since their inherited frameworks just didn't leave them room to do so. More and more I saw my work cut out for me: to show the obstacles on the way toward a future unification, in the hope thereby to find avenues to overcome them and thus accelerate the development of such a future theory. Meanwhile, I had no way of knowing that I would soon receive inspiration from two very different personalities.

the Tao of physics

Just around the time of my graduation, while I was about to start my Master's studies, a book came out that made quite a splash: the Tao of Physics, published in 1975, by Fritjof Capra. It was the first widely read popular book that pointed to some interesting parallels between the world views of Eastern contemplative traditions and modern physics. As such, it performed a great service in broadening many people's horizons.

However, its weaknesses quickly became obvious to me, even before I got a chance to read it. My physics friends told me that the Eastern stuff was all an eye opener, fascinating in itself, although the physics part of the book was not worth reading, relying heavily as it did on one particular interpretation of particle physics that was already clearly on its way out. And guess what: my contemplative friends told me that the treatment of physics was an eye opener for them, fascinating and clearly written, although the contemplative stuff was not worth reading, rather superficial and disconnected.

Upon reading the book myself, I had to agree with both sides in their part-way criticism. I concluded that, much as the book had opened a new direction of popular interest toward unification of theories of mind and matter, it failed in pointing the way, and worse, it put off people who were more serious in really trying to go beyond the rather superficial parallels that were drawn in the book.

meeting Stephen Hawking

Not much later, in 1976, while working on my Master's thesis on the thermodynamics of black holes in Cambridge, I had the privilege of getting a chance to talk with Stephen Hawking. His speech was still understandable, but barely so, and soon afterward he could only communicate via an interpreter who knew him really well, until a special computer was developed to allow him to communicate via

speech synthesis. While mulling over the consequences of Hawking radiation at work, I began to see the contours of the rest of my career.

Inspired by the tenacity of Stephen Hawking, who against all odds made a momentous breakthrough toward the unification of gravity and quantum mechanics, and by the broad vision of Fritjof Capra, no matter how flawed in its limitations, to find connections between physics and contemplation, I made a firm decision.

I saw that the greatest contribution I could make toward a unification of mind and matter was to write a book like the Tao of Physics, but this time in a way that could be equally appreciated by scientists as well as contemplatives. While obtaining a PhD in physics, I also wanted to develop an equally deep understanding of the kind of nonduality that contemplatives talked and wrote about in all major traditions I had already sampled, from Medieval Christianity via Sufism to Hinduism and Buddhism to Taoism to various indigenous approaches. Only then would I feel qualified enough to share an authentically grounded experience with a wider audience.

I knew it would take quite a while. And I also knew that nobody was going to pay for my living during all the however many years it was going to take to prepare for and then write that book. So I continued to do what I also enjoyed, pursuing research in physics and astrophysics for a living, while continuing to explore the theory and practice of contemplation equally seriously as science.

Facing the choice of making a career mainly in particle physics or astrophysics, I chose astrophysics. While in particle physics I had been one of the early researchers calculating scattering processes involving Higgs particles in 1977, I had a sense that it might take awhile for the Higgs particle to be discovered (35 years, to be precise!). Indeed, the seventies were the last golden age of discovery of new particles, while astrophysics continued to produce spectacular new discoveries on a yearly basis. As a

specialization I chose stellar dynamics, about which I would later write a graduate text book, *The Gravitational Million-Body Problem*, with my Scottish colleague Douglas Heggie.

why it took me so long

Little did I know it would take me more than forty years to write the book of my dreams, the book that you are now holding in your hand or reading on a screen.

What took me so long? It was not that I am such a perfectionist. I had no trouble authoring and co-authoring a couple hundred scientific articles, a graduate textbook, and several edited volumes. And I am sure there are many aspect of this book that can be easily improved and extended toward more details. I hope to do so myself, with the help of co-workers, over the years to come. The cause lay elsewhere.

In short, I wanted to be understandable.

I always felt, and still feel, that I do not need to be understood. Being understood is not my responsibility. I saw my task as something much more straightforward: to write in such a way as to be understandable by both my fellow scientists and my fellow contemplatives. And each part of this task requires depth and breadth. Depth to reach each community and breadth to connect them with the other community.

For my fellow scientists, I needed to anticipate their (for them) natural objections and explain why those are not showstoppers in my attempt to point to ways to unify mind and matter. I needed to argue in (for them) believable ways that contemplation is not just a form of superstition, or navel gazing, or outdated nostalgia, or a kind of relaxation that can equally well be gained by going for a swim or taking a shower.

For my fellow contemplatives, I also needed to anticipate their (for them) natural objections and explain why there are no showstoppers. And I needed to argue in (for them) convincing ways that scientific inquiry does not necessarily lead to a blind reductionism in which the workings of the mind are reduced to a play of chemicals and electrical impulses, and anything of value is sacrificed on the altar of myopic facts.

What took me so long, 42 years to be precise, was my search for ways of reasoning and forms of explanation that would not by its very nature shut the door for either scientists or contemplatives. After 17 years, in 1993, I finished my first attempt to write such a book manuscript, "Freedom from Identification", but after rereading the whole text myself, I concluded that it was too dry, and what is more, not convincing enough for those who either had not been really exposed to science or to contemplation or both.

In other words, I knew that I could not be clearly understood at that point, and that I had failed. So I tried again, in 2004, with a manuscript "Life as a Lab", and again in 2011, with "the Magic of Time". In all three cases, I knew I wasn't yet ready, even though I came closer with each attempt. It was only with my current fourth attempt, that I felt my writing had gotten good enough to see the light of day.

from space to time, in exploring subject/object reversal

So far, we have worked with reversing the roles of subject and object in spatial terms, whether visually or using other senses. Let us now explore a reversal in terms of temporal relationships.

Choose a time in the future, say an hour from now, or some time tomorrow. Picture yourself where you think you might be at that time. For a short while, acquaint yourself with the typical way we cut up what appears to us in our mind: the you here and now as the active subject, and the imagined you in the future as the passive object.

Then try to reverse that relationship, giving the active role of the subject to the anticipated you, while taking a more passive role yourself as the object pole. In other words, let the future you remember the current you. How does it feel, to play the role of a memory of your future self?

After doing this a few times, you can look back in time as well, letting a remembered self, of yesterday or of any other time in your past, anticipate the current you.

Many other variations are possible, as I'm sure you can improvise with yourself, for example by combining spatial and temporal reversals, or letting your thoughts think you rather than you thinking your thoughts or your emotions feel you. The possibilities are endless.

* * *

Part II. Introducing Contemplation

Chapter 6. What is Mind?

My best guess for the next revolution in science to occur is a unification of our leading theories of matter and mind. As I argued in Part I, this guess strikes me as the most conservative possible while still being truly revolutionary.

The first obstacle for such a unification is the fact that we don't have a leading theory for mind. This stands in stark contrast with the beautiful theory for matter, called the standard model, that has unified our best theories for the strong, weak, and electromagnetic forces. So far, gravitation has still resisted all efforts to be included in a truly unified theory of matter, but it is generally believed that it will be only a matter of time before such a theory will be discovered.

However, from the side of the mind, there is nothing that deserves to be called a 'standard model'. It is not even clear in which direction to search to come anywhere close to anything that would deserve such a name. Most scientists assume that a more detailed study of the material structure of the human brain may lead to a growing understanding of the human mind. But not everybody holds that view, and there are good reasons to doubt that a reduction of mind to matter will produce more than shadows of the mind, projections of only certain quantifiable aspects.

Simply put, it is not clear whether an objective, third-person description of matter will ever succeed in catching the essence of our subjective, first-person experience. The language for describing the electrical and chemical processes in the brain has no correspondence with the kinds of languages we use for describing our thoughts and feelings as we experience them. This of course does not mean that no convincing language will ever be found that

can be considered to provide a successful unification, but at the very least it should give us reason to pause.

a tower or a bridge?

Given the huge success of our best theory of matter, which has led to unifications of space and time, as well as matter and energy, it is tempting to start at the side of matter, and try to build a theory of mind on top of our theory of matter. This would be akin to building a tower, with math and physics on the lower floors, up to chemistry and biology, then neuroscience, and above that finally a theory of mind, each discipline layered on the one below it.

However, if our current natural science methodology turns out to be intrinsically limited, we will need help from elsewhere. But from where? The most conservative approach would be to look at the past, and see how new directions were explored when an existence methodology needed to be extended. And we don't have to look far: the Aristotelian worldview is the most striking example, having reigned supreme for some nineteen centuries until it was overhauled in the seventeenth century.

The process of extending our understanding of the material world would take more than a century, from the posthumous publication of Copernicus' *De Revolutionibus Orbium Coelestium* in 1543 to the first publication of Newton's *Philosophiæ Naturalis Principia Mathematica* in 1687. The key to the extension was the building of a bridge from the empirical dynamics of objects on Earth to the observational dynamics of objects beyond the realm of the moon. As we saw in chapter 3, from Copernicus who started to build a bridge to Newton who completed it, the result was a wider framework that encompassed empirical and observational results without trying to reduce one side to the other.

All other successful unification attempts, earlier or later, were examples of bridge building, rather than marking one

side as having to shoulder the other. Alas, mistaking a bridge for a tower is all too easy, since towers are simpler to design and visualize. Starting where you are, you just add layer after layer of bricks to make a vertical path. In contrast, planning to construct a bridge requires peering into the distance toward a dimly discerned other shore.

A case in point is the early objection against Darwinism, in the caricatures that showed Darwin as an ape evolving into a human. Many people, even now, don't realize that Darwin's theory of evolution was meant as an explanatory bridge between the similarities of humans and apes. Hence the still popular mistake that Darwin saw us as the product of apes evolving into humans. They contorted Darwin's beautiful bridge theory into a silly tower.

deeply ingrained tower thinking

Even if we are willing to think more broadly, in terms of bridges, it is not always easy to rid ourselves of deeply ingrained habits of thinking in terms of towers. In general, bridge building, as well as tunnel digging, is easier done when starting at both sides and meeting somewhere in the middle. But when we see one side of the bridge so clearly, like a tower we can touch, but have no idea about the form or even the existence of the other side, what to do?

Concretely, what could it mean to start building a bridge also from the other side, the side of the mind? How can we study the mind using the mind without relying right away on any detailed descriptions of matter?

Before trying to answer that question, let us make fully sure that we become aware of the currently so ingrained tower thinking within the academic world, where much of the research on matter and mind is conducted.

Within academic research, natural science by definition starts with material descriptions. However, social sciences, too, start with the assumption of a material world, given in

terms of space and time, populated with processes involving matter and energy. Even most forms of philosophy don't seriously doubt that the game of developing better descriptions of reality should be conducted within the framework of a material world.

Even though any theory of matter is formulated in our minds, we tend to believe without question that the content of our theories point to something more real than and fully independent of our minds. Our empirical research methodology is carefully crafted and discussed in great detail but rests on an unquestioned belief in the reality of the material arena as what grounds everything else, all other theories that we so carefully craft and discuss. It is that belief that forms the foundation of our tower thinking. And as you may have noticed, in the explorations that were suggested at the end of each chapter in Part I, putting subject and object on a more equal footing is an example of moving from tower thinking to bridge thinking.

exploring the other side of the bridge

A rare exception to tower thinking can be found in the philosophical school of phenomenology, founded by Edmund Husserl a little over a century ago. He and others in his tradition developed systematic approaches to studying all phenomena that we encounter in our conscious experience without assuming anything about any underlying reality status. In other words, whether analyzing a dream or fantasy, or an everyday occurrence within our waking experience, phenomenology strictly sticks to a description of patterns in the phenomena themselves, not in presuppositions that are habitually smuggled in. And it does this while suspending any judgment about what may be considered to be real and what might not be, according to any framework whatsoever. This will be the topic of our next chapter, Chapter 7.

What about studies of pre-scientific traditions, such as in departments of comparative religion? There, too, the

general attitude has been, at least throughout most of the twentieth century, to consider the material world as given, and more specifically as given according to our current scientific understanding. From that starting point, the various cultural systems under study are then seen as playing out within the playpen of a material world as the substrate spread out in the arena of space and time. Seriously considering the various traditional belief systems to be possibly true in some sense was often seen as a dangerous form of 'going native' and thus losing one's objectivity.

Yet, built-in beliefs about the superiority of the material pole of descriptions of reality in itself belie the notion of open working hypotheses, which require the temporary suspension of both belief and disbelief in the truth of any hypothesis at hand. If we ever want to try to build a bridge between theories of mind and matter, we have to drop any such a priori assumptions. What strikes me as the most open-minded approach is to use the attitude of Husserlian phenomenology in studying the rich variety of traditional, pre-scientific approaches to studies of the mind. This will be the topic of the chapter after the next one, Chapter 8.

the continuity of knowledge acquisition

Most working scientists, as well as engineers, medical researchers, or others using applied science, consider modern science to have started only a few centuries ago, without giving much thought to its pre-scientific roots. But without the growing scientific thinking during the Middle Ages -- and before that, from the Greek roots through the Islamic period, when much of Greek knowledge was passed on after having been lost in Europe -- modern science would not have gotten off the ground.

Going back even further, Greek astronomers used the extensive database of Babylonian astrologers. They were not interested in the particular religious and political interpretations that the Babylonians connected with the

positions of stars and planets, but they were happy to use the data to built up their models, which eventually would lead to the Ptolemaic system, which remained the most accurate theory of planetary motion for one and a half millennia. The Greek attitude was one of fun and profit: "hold your Gods but give us your data to play with."

Similarly, modern chemistry didn't try to start from scratch either. They were happy to take the database that the alchemists had built up over many centuries. Leaving out ritual instructions like incantations and actions that had to be performed during full moon, they were grateful to use the detailed alchemic knowledge of what reacted with what in which way.

In fact, there is no current form of natural science that has not been dependent on some pre-scientific database in order to get started, from physics to astrophysics and geophysics, to chemistry and biology.

This poses the question for those of us interested in a future unification of matter and mind: wouldn't it be natural to follow the example of natural science? Wouldn't it be most effective to study the pre-scientific databases that have been built up, mainly in Asia, over dozens of centuries of empirical studies of the mind?

We do not need to buy into the religious or political systems that are associated with Taoism, Buddhism, Hinduism, Sufism, or Christianity and Judaic forms of mysticism -- as little as the Greeks needed to delve into the cultural background of the universal patterns that the Babylonians had discovered. If history has taught us anything about the growth of science, it is the lesson that it would be prudent to look for existing empirical databases, rather than starting from scratch.

We will come back to this in Chapter 9 to make some inventories, while in Chapter 10 we explore ways to put such inventories to new use. In these chapters, we will adapt the Greek pleas to the Babylonians: "hold your political systems,

but give us your spiritual data to play with, so that we can explore those afresh."

playing with our views of reality as 'really real'

In Part I we started playing with the relationship between subject and objects as we encountered them within our field of experience. We discovered how easy it was to loosen up our habitual fixation on identifying with only the subject pole of our experience. Once we empirically realize that everything we are aware of is given in our mind – objects, subject, as well as their relationships -- the notion of an 'open mind' suddenly can become more of a gut feeling rather than some theory we carry 'in our head'.

In this Part II, let us now see to what extent we can loosen up the rigidity in our beliefs concerning the nature of reality. First look at a material object -- a cup, table or wall, anything will do. What makes us so convinced that it has a reality of its own, independent of us looking at it? For starters, pose that question and see what answers naturally bubble up before trying to put on a philosophical or scientific or other type of hat.

One answer could be: it sure feels real. We can see it, touch it, all of our experience cries out for it to be real. But what if this question would be posed to us within a dream? Wouldn't it feel equally real then, and would we not answer with full conviction that the cup or wall would 'of course' be real?

In the annals of western philosophy, there is a fun anecdote about Samuel Johnson, an English writer, who was asked to comment on the view of Bishop Berkeley, an Irish philosopher, of the unreality of matter. Johnson kicked a large stone with great force, saying "I refute it thus." But of course, all that he showed was that in his mind there occurred a strong tactile sensation, correlated with other sensations, such as the visual sensation of a stone, and the delight he must have felt of having found a clever response.

The exploration I suggest you to embark on from time to time is in the spirit of Sam's stone kicking but without believing in the reality of mind, as Berkeley did, or in the reality of matter, as Sam did. Instead, try to suspend judgment. How does it feel, to just leave the question of reality of both mind or matter open?

Here is a hint: when we feel convinced that a stone is real, or that our touching a stone is a sign of its realness, focus for a while on the conviction that we feel. Recognize the conviction as a occurrence in our consciousness. And when we then ask whether that conviction of the reality of a stone points to its actual reality, a meta conviction may arise that the first conviction really is a significant piece of evidence for the reality of the stone.

Keep playing with this for a while, and see to what extent you may become aware of the unquestioned frameworks that we all tend to buy into and that shore up our sense of reality. Perhaps you will get a taste of the way that convictions rest upon convictions, like a house of cards, something that we will discuss in more detail in Chapter 20, when discussing the Madhyamika approach of Nagarjuna.

* * *

Chapter 7. What are Phenomena?

In the mid-nineties, soon after the world wide web was invented, more and more of my friends and colleagues started their own websites, while it was still a very novel thing to do. It seemed like fun, so I learned some html, about the only web language available in those days, and made a simple home page. But what to put at the top? Looking at what others did, I saw mostly "under construction", a popular phrase in those days, or just name, profession, address.

Neither option seemed like much fun. So instead I put a couple of my favorite quotes there. I checked whether my memory served me well, by looking it up on the internet archive Wayback Machine, which had a copy of my home page, retrieved in 1997, of all days on April Fools' Day, as it turned out. The two quotes were:

> Zu den Sachen selbst [Edmund Husserl]
>
> To be radical, an empiricism must neither admit into its constructions any element that is not directly experienced, nor exclude from them any element that is directly experienced [William James]

The first quote, in German from 1900, translates as "to the things themselves". Edmund Husserl, the German philosopher who founded the school of phenomenology, considered this the starting point of philosophical investigations. Where scientists rely on empirical facts, Husserl starts at an even earlier grounding point, with phenomena; any phenomena, perceptions, memories, fantasies, thoughts, feelings, etc. These are the things he wants to study, as they present themselves, as much as possible without adding any interpretative framework that contorts them. Everything else he saw as building on that.

The second quote, from 1904, is from William James, the American psychologist/philosopher, about twenty years older than Husserl, when he developed his notion of radical

empiricism toward the end of his life, around the same time that Husserl embarked on his life-long project of establishing phenomenology.

how to be not-so-radically empirical

Natural science prides itself on its empirical method. The Greek, in their natural philosophy, focused more on mathematics and philosophy to explain what they saw in nature. But by the end of the Middle Ages, Europeans began to combine those two fields with technology and engineering. This led to the birth of natural science, based directly on empirical evidence through observation and experimentation.

The word empirical is derived from the Greek word empeiria (ἐμπειρία), experience. For there to be an experience, there needs to be an experiencer, who experiences something. From the start, natural scientists got a lot of mileage out of their empirical approach by stripping off two-thirds of the show. Like the early photographers, who hid themselves underneath a black cape, or kabuki stagehands dressed in black, they put themselves out of the picture, thereby leaving out the experiencer. And for a few centuries, until 1925, they also left out the process of experiencing, focusing only on what was experienced.

With this sleight of hand, the something that a scientist experienced was considered as stand-alone, bare facts. This turned out to be a spectacularly useful trick, an approximation that was good enough to lead to the development of classical mechanics, fluid mechanics, thermodynamics and electromagnetism, to name a few. Beyond all expectations, being only a little empirical went quite a long way; being only what I would call “one-third empirical” was good enough.

It was much later, with the advent of quantum mechanics, that the realization dawned that the process of experiencing, and the determination of what it is that is

experienced, are intrinsically interwoven. Purely quantum mechanical features like the uncertainty principle and entanglement show that we cannot separate an objective stand-alone 'something' from a measurement that tries to measure some thing. The greatest accomplishment of quantum theory was to make physics twice as empirical: “two-thirds empirical” to be precise, in my terminology.

how to be fully empirical

Given this history of science, not explicitly empirical for the Greeks, one-third empirical from Galileo to Heisenberg, and two-thirds empirical in the century since then, what can be more straightforward of an extrapolation than predicting science to become “fully empirical” as the next step? I can't think of any stance that is more conservative than assuming that science soon will learn to include the experiencer, as the missing link, into its empirical method.

This will imply treating the subject pole of experience equally serious as the object pole and the interaction between the two. To be fully empirical, what William James called radically empirical, implies a double extension of the original empirical method of natural science. After developing a language appropriate for the object pole, in the form of classical mechanics, and an extended language appropriate for interactions, in the form of quantum mechanics, what we are waiting for now is the development of a language that offers room for an authentic treatment of the subject pole of experience.

I consider James and Husserl as forerunners to this future development. Like Leonardo da Vinci making drawings of helicopters, centuries before the technology was finally developed to build them, they presaged a type of full-grown and complete empirical method, more than a century before it may be developed in any detail in science. They acted as catalysts toward these future developments, and I see my role as taking over the baton from them, and passing it on to future generations of scientists.

We don't know what form the third act of natural science will take after the classical and quantum acts. What we do know is that there will be a lot of initial resistance against entering a new act from those who have spent their whole lives fine tuning an older act. That is only to be expected. And like with the discovery of quantum mechanics, called Knabenphysik (boy's physics) in its early years in Germany, the discoverers are likely to be in their twenties if history can be extrapolated -- which I think it can, as a card-carrying conservative.

playing with time

During our explorations in the first five chapters, we have been flexing our investigative muscles as warming-up exercises to becoming fully empirical. We've invited the subject pole of experience to come to the fore, thereby familiarizing ourselves with what it feels like to play the roles of both subject and object.

In the sixth chapter, we capitalized on our new-found freedom from habitual identification with the subject role, by questioning our culturally inherited views of reality. We will now extend that exploration by an even more radical questioning of the nature of time. Sit back, relax, but please keep your seatbelts fastened, since the following exploration may encounter unexpected turbulence.

Most of our waking time, we spend remembering and anticipating. We bathe ourselves in streams of memories about things we did or encountered in the past, with joy and regret and many other emotions, as well as in streams of expectations about the future, with anticipation that can carry hope and fear, excitement and dread, and many other emotions. We are calibrating our life based on the past, while evaluating what the options are for a better life in the future. All of that keeps us quite busy, with little time to really relax. Let's see whether we can counteract that life-long habit.

Please sit back and put your mind in neutral, so to speak. Watch what bubbles up. Most likely, it will still be a mixture of past and future, memories and anticipations. After a while, ask yourself: what is our empirical evidence of the reality of past and future?

Specifically, focus on the fact that all memories are present memories of the past, and all anticipations are present anticipations of the future. We can never, ever, re-enter the past nor can we jump into the future. We, that is, our experience, which is all we got, is thoroughly chained to the present. And within the present, we use present memories and present anticipations and present judgments to figure out what stance to take in the present.

That's all! Purely phenomenologically speaking, that's it. How about reflecting on this for a while. We are born in the present, live in the present, and we will die in the present. All the while we try in vain to teleport ourselves within our memories and anticipations to an inaccessible past or future, often overlooking what is happening right now, right here in the present.

In short, the past or future existence of reality is a speculation, the kind of armchair speculation that proverbial philosophers are fond of. The only empirically accessible time is the present. It is important to really feel this, sense this in your guts, since we will build upon this in further explorations in later chapters.

* * *

Chapter 8. Toward a Fully Empirical Methodology

It took roughly a hundred years to establish the currently accepted empirical method of modern science. During the seventeenth century, through the efforts of scientists like Galileo, Bacon, Boyle and finally Newton, this method was developed as a systematic way to study objects in nature. When high school students are presented with this empirical method as 'how you do science', they may not be aware of the enormous intellectual effort that went into the invention, the establishment, and the general adoption of the scientific method based on empirical investigation.

After the discovery of quantum mechanics, it took another hundred years to figure out how to adjust the seventeenth century legacy of a one-third empirical method, to produce a full fledged two-thirds empirical method, using the terminology that I proposed in the previous chapter. That process of adjusting is still in progress, with frequent new discoveries about the nature of quantum computing, and the resulting ramifications for the empirical side of quantum theory. Sadly, by and large, little of this fascinating expansion of the empirical method has so far trickled down to the high school curriculum.

Extrapolating, we can expect the final adjustment, to an empirical approach that includes a study of the subject pole of experience, to take on the order of a hundred years as well. I expect this process to take us well into the twenty-second century, depending partly on when serious efforts will be started toward the development of what I called fully empirical approaches to the study of the world. As I mentioned at the end of my preface, if this book can inspire a single high school student to focus on this central problem with the tenacity it takes to discover a whole new approach to the study of nature, it will have been worth the fifty years of study and research in science and contemplation, that I put in before I could write the book.

the virtue of being conservative

In my estimates of how science will develop in the near and mid-term future, and of how long the various processes will take, I consider myself to be an arch conservative. I don't see much use in making seemingly random guesses as to the future progression of science, such as: "we don't understand X and we don't understand consciousness, so let's assume X is related to, or even the cause of, consciousness." I have seen too much of such speculation and have grown tired of it.

It reminds me of one of the highlights in my undergraduate classes. A popular physics teacher at the time at the University of Utrecht, Henk Nauta, was asked about his political views, whether he considered himself progressive or conservative. In response, he acted out his answer. He said that being conservative was always a good start, continuing to walk in the direction you did, while then making careful adjustments. In doing so, he took a few steps in a straight line, while slightly veering toward a new direction.

On the contrary, according to him, being progressive is meaningless. He twirled around, and landing in a random new orientation, he then walked forward and declared: look at me being progressive! He twirled a couple more times like a dervish, and each time took a few more steps in each newly discovered way of progressing into a different direction. Showing so vividly how random the idea of "going forward" was, depending on the direction your nose was pointing in, resulted in a thunderous applause by the students, even while most of us considered ourselves politically 'progressive'.

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It is in the spirit of professor Nauta, that I consider this whole book to be as conservative as possible in its approach towards outlining what I see as the most likely path that science will take. I do not mean the term 'conservative' in the way it is used in politics, where parties calling themselves conservative tend to do a lot more damage to the environment than parties calling themselves progressive. Paradoxically, the latter often show more respect for the need to conserve the environment. But then again, politics only seems full of paradoxes until you discover that the frequent inconsistencies are driven by an underlying power-play dressed up in questionable logic.

Perhaps I should call my attitude one of "progressive conservatism", a way to progress further in an established direction, with great respect to what has been done in the past, but with a willingness to make adjustments, if and when and where really needed, in an evidence-based way.

the epoché as the first attempt at being fully empirical

While James and Husserl pointed in similar directions, in advocating a fully empirical method, it was Husserl who actually made the first concrete attempt in formulating such a method. He gave it the name 'epoché', pronounced ‘epokhē’, from the Greek word 'suspension' (ἐποχή), since he saw his method as a suspension of judgment with respect to all the unstated assumptions that we carry with us, concerning the details of the reality status of all that we encounter in the world.

Simply put, the epoché was Husserl's way to investigate the nature of reality without buying into any preconceived versions of reality, leaving any and all aspects open to both experiential and theoretical scrutiny. Specifically, Husserl wants us to taste what it feels like to put the reality of the world 'on hold', making no judgment as to whether the material world we find ourselves in is ultimately real – and

more importantly, as to what it could possibly mean to be 'real'.

We can indeed put (our notions of the reality of) the world on hold, not in order to doubt the reality of the world as Descartes did, but instead to feel very directly what part of our experience makes us feel so sure about the reality of the world. It is like investigative journalism, traveling as an embedded journalist within our own life stream, reporting what it is like to be convinced of the reality of our world, while investigating the consequences of that conviction.

what the epoché is not

Normally, when we ask ourselves whether an object we look at or hold in our hands is real or not, we don't have much trouble answering that question. A tree is just a tree, and we are pretty sure it really exists, there in front of us. However, when we are in twilight, and a tree in the distance is only dimly seen, it may temporarily look like a person, perhaps even a threatening figure that makes us wonder whether to continue walking in its direction.

Also, while we are dreaming, we are typically convinced that the trees we see in our dream are real, only to find out that we were mistaken after we wake up. In both of these cases, judging whether something is real is not necessarily straightforward. Even so, while you are reading these sentences, you can be pretty sure that you are not confusing this book or screen for something else, and that you are not dreaming (reading typically doesn't work very well in dreams). So these arguments are not the main reason to perform an epoché.

what the epoché is

Husserl's aim with the introduction of the epoché lies elsewhere. Even while acknowledging that we can be pretty sure that we are awake and not confused about the reality

status of a particular object, we can still inspect within our experience what it is that makes us so sure. What is this conviction? When we look at it, can we wear it loosely, so to speak, rather than fully identifying with it? Can we try to suspend our firm belief that the material world around us is real? When we stop busily driving around in this hectic world of us, and allow ourselves to switch into neutral for a while, then what happens? How does it feel when we do that?

It is easy to *imagine* performing the epoché. Okay, here is the world, it could be unreal, unlikely as it may seem. Fine. In that case, we would still have the conviction that it is real. Okay. So what?

When somebody reacts in this way, it is a sure sign that he or she has only thought about the epoché, and has not actually *performed* the epoché. It takes quite a while to learn how to really embark on this journey, to feel in your bones that this world could in principle be as illusory as a dream or a fantasy. Husserl himself complained in letters to close friends that he was often in despair about the fact that so many of his students just didn't seem to 'get' it, while only some others did, and he didn't quite know how to let the first category 'fall into' the experience of a deep, lived epoché.

It is a bit like knowing theoretically that you're going to die, and then one day that realization grips you with a shocking certainty. Only here it is the opposite: having always assumed the reality of our world, one day to let the realization of the epoché grip you with the shock of uncertainty.

Or it is like knowing how to enjoy the nice weather as you normally do, and making your first steps outside one day after a long serious illness, only to be overwhelmed by a deep sense of appreciating the weather -- any weather, rain or shine -- in an overpowering appreciation of still being alive. Compared to a rational description, a gut feeling of the same theoretical informational content has a completely

different impact. We'll continue to explore this in the next chapter.

an epoché of time

There are many different ways of performing an epoché. One of the most radical forms of epoché is to suspend the judgment that time is real – more precisely, that time has the *kind* of reality that we ascribe to it. At the end of the previous chapter, we noticed how we always only have access to the present. While we can think about past and future, what we have direct access to is only our present thoughts about past and future and our present contents of those thoughts.

How about taking your time, for at least a few minutes, to sense what it feels like, to live in the "bubble of the present" as a complete universe in itself, with no entrance, exit, or windows, temporally completely self-contained.

Make sure to make this a lived and deeply felt realization. You can ask yourself simply: is there any empirical way to reach out of this "bubble"? Any answer that may bubble up, pun intended, when looked at clearly will be a theory, not an experience.

Yes, we can point to the fact that we know what just happened a minute ago. We experience that knowledge, but while the content of that knowledge (what happened a minute ago) is labeled as "what happened in the past", the direct concrete empirical fact that presents itself can only present itself in the present, as the firm belief that this present knowledge reliably conforms to something that happened in the past. But 'conforming to' is a rational construction, while the empirical finding itself, as well as the rational construction of its meaning, are both found in the present.

After these warming up exercises, you may feel ready to perform a time epoché. Find yourself a quiet place, in an empty room or a cafe where for a while nobody talks with you, or go for a walk in a relatively undemanding environment. After a while, ask yourself how it would really feel if past and future would not exist, that is, if only the present were real.

Try to sense the enormity of contemplating that possibility. Here is one way to help you realize how deeply such an exploration could affect the way you are viewing your life and habitually lived world. If someone would point a gun at you, and threaten to kill you, that person could effectively take away your future, but without a time machine at hand, he or she could never take away your past, could not prevent you from having lived. The time epoché goes further, using a move in some ways more powerful than a gun: it asks you to imagine what it would be like if you would lose both the future and the past, and be left only with the moving present, here and now in this moment.

* * *

Chapter 9. Epoché and Contemplation

Unbeknownst to Husserl, his explicit method of radical empiricism, while novel within European science and philosophy, was not really new. It was a rediscovery within a new context of an ancient device, used by contemplatives in many traditions, East and West, past and present.

A general theme throughout this book is to compare, and where possible connect and mutually inspire, science and contemplation. Since contemplation is a rather loosely used term, with different meanings for different people, let me start with a short description of what I have in mind here.

Throughout history there have been individuals who were not satisfied with the views they inherited from their surroundings. Rather than following the values that were offered to them in their culture, whether the value of accumulating money, or of building up a reputation, or chasing after pleasures of various sorts, they were looking for something altogether different.

rebels of many stripes

In general, people don't know what to make of these rebels who appear at every age, in every society. Most of them are considered as simply odd by their contemporaries. Why forego money, fame, and fun, for an odd 'higher fun'? At best they are ignored, at worst they are killed because they are seen as threatening the status quo, and in most cases their fate lies somewhere in between. And on very rare occasions they wind up being venerated, often after their death, as being exemplary, which in turn may attract large groups of followers, who may build institutions around their memory – ironically institutions deeply wary of rebels!

There is no established general term for these people, their activities, or their views, even though they can and will occur anywhere, from time to time, and at any time period,

in one place or another. In Christianity they tend to be called saints or heretics, depending on their fate. In other traditions words like prophets or false prophets are used, as well as gurus or fake gurus, or they could be labeled as shamans or charlatans, white or black magicians or witches, or a whole host of other names, depending on local culture and prejudices.

When they trigger a new movement, it is called a sect or a religion, depending on the size. This resembles the distinction between a dialect and a language. This kind of distinction is mostly based on power: an apt definition of a language is that it is a dialect with an army and a navy. Similarly, established religions are often established by the sword, by a local ruler forcing his or her own conversion onto the population, or by a neighboring ruler overthrowing the local ruler and forcing or at least strongly enticing conversion to the creed of the new ruler.

a choice of words

Many of these rebels could be called seekers, though among them they were often seeking quite different things. In this book I am interested in the kind of seekers that I will call contemplatives. Correspondingly, their method of seeking I will call contemplation – although what they found was often not what they were looking for.

I will use this term in a rather broad sense. Examples of contemplatives for me are Christian Medieval mystics, Ashkenazi Hasidim, Sufis, as well as many Hindu, Buddhist and Taoist practitioners pursuing a deeper understanding of the world, beyond what is suggested by common sense.

Contemplation can take the form of meditation or prayer or mixtures of both. A general term often used these days is spirituality, but since this notion is used so widely that it can point to almost anything, I prefer the more neutral word contemplation, also because it does not suggest any

undefined role for spirit(s), emphasizing only the act of contemplating the nature of reality.

contemplation and religion

Most contemplatives grew up within, and by and large stayed within, a particular tradition. In Europe and the Middle East, we call such a tradition a religion. Examples are Judaism, Christianity and Islam, in that historical order. Further East in Asia, Hinduism, Buddhism and Taoism have often been called religions as well, although the use of that European term is more questionable for various reasons. For one, their organizational structure can be quite different from that of the Abrahamic religions. For another, they typically include aspects of what might be more properly called science, technology, psychology, or other classifications.

In each such tradition, the number of contemplatives is only a tiny fraction of the people who consider themselves to form part of that tradition. In most cases, the leaders of the traditions are more focused on organizational issues, related to practical management and theoretical studies of scriptures. Yet contemplation is the living source from which any tradition stems, and through which the main rejuvenations of those traditions occur from time to time.

We may draw a loose parallel between science versus engineering, on the one hand, and contemplation versus other religious activities, on the other. Scientists are expected to be able to discover new aspects of the structure of material reality, while the role of engineers is to apply scientific insights to the construction of technology that benefits society at large more directly and concretely. Similarly, contemplatives claim to explore the most basic nature of reality, while the majority of other religious leaders are involved in activities that support more directly the structural aspects of a religion and the concretely felt needs of its congregations.

science, phenomenology and contemplation

Having defined my terms above, I can now describe the roles of scientific, phenomenological, and contemplative investigations, their parallels and their differences.

What they all have in common is the notion of suspension of judgment. Scientists use a working hypothesis, with the explicit starting point of neither believing nor disbelieving the content of the hypothesis. Rather, they work with it to see whether the accumulated evidence will eventually fall toward one side or another, toward confirmation or refutation of the working hypothesis.

Phenomenologists, using the epoché, are more radical than scientists in that they want to put on hold any and all implicit assumptions, such as the reality of the common view of the world as being given as a complex dance of matter and energy in space and time. Following the pioneering investigations by Descartes, Kant, and others, Husserl continued their tradition of questioning the status of our normally unquestioned belief in the reality of the world. But instead of Descartes' method of doubt, or Kant's method of positing a priori conditions on what we can know, Husserl made any and all phenomena themselves into a topic of active empirical explorations.

In doing so, while extending the European philosophical tradition after the renaissance, he also reinvented the wheel in questioning the status of all of our experience, something that contemplatives before him had done for thousands of years. A central part of contemplation is to question the reality of the subject of experience. As we will see later on, Husserl introduced a 'transcendental subject', like what Kant used, yet in a more interactive way. But he still fell short of fully putting on hold a received belief in the reality of the subject of experience. In that sense, his phenomenology does not yet form a bridge between science and contemplation but rather a series of stepping stones. We will discuss this further in the next chapter.

deepening our epoché of time

Continuing our exploration of a time epoché from the previous chapter, here are some extra aspects that you might begin to notice. After familiarizing yourself with the possibility to not only imagine but also actually feel and sense deeply what it may be like to suspend your normally firm belief in past and future, more surprises may be in store.

At first, after putting past and future on hold, it may appear that all we have left is the present. But what meaning would the present have without past and future? It would no longer be a tiny point along a one-dimensional time line stretching huge distances into both past and future. Upon further investigation, you may feel how the newly won present can open up, to much more than a point or a confining bubble into an open expanse that allows anything whatsoever to happen without restrictions.

Or you may not, which may be more interesting, giving you something new to look for. In either case, just reading and understanding the word by word meaning of what you just read is not enough. Please try to go beyond the letter of the descriptions, and explore the possibility of falling into a new way of experiencing the world, in fact, experiencing both self and world as if for the first time. In the first few chapters of this book, you may have seen how easy it was to find new ways to flex our subject/object muscles. Flexing our mental muscles of the sense of the presence of the present is not much harder.

Staying within the spirit of a working hypothesis, of imagining without believing and disbelieving, what does it feel like to imagine the unreality of past and future? What are the implications?

For one thing, it will be a lot easier and more natural to let go of our identification with a fixed personal history. Even if we manage to do that to a small extent, we

may become more spontaneous in our responses to a new situation.

For another, our personal future may become much less constrained by projected obstacles from the past. We may become more creative in finding solutions to new problems, when we don't feel the need to define them in terms of our old shortcomings.

For yet another implication, we may even become more liberated from the kind of personality that everyone, including ourselves, expects us to carry forward as an established set of patterns.

How about exploring the consequences of dropping a firm belief in your own personal history as well as your own historically constructed personality? If you consider yourself to always only live in the present as a much more rich and dynamic open-ended reality, it may become much easier to loosen up the strictures of the past and become more playful -- to the point of playing quite different roles than you have habitually done so far in your life.

* * *

Chapter 10. What Can We Learn From Ancient Traditions?

Ancient traditions have much wisdom and insight to offer in many areas of human life. For the purpose of this book, however, the question is how to sift through all the information we have about ancient traditions to focus on the bits and pieces related to the epistemology and ontology of the world, mind and matter. Or to put it in less philosophical terms: how we can investigate reality, and what we can expect to find in doing so?

In short, we are embarking on an exploration to study the possibility to integrate science and contemplation to achieve a unified approach toward an understanding of the nature of matter and mind. For this purpose, what aspects of contemplative traditions should we focus on?

First of all, I will limit myself to those traditions that have a written history, and mostly to traditions that still have living representatives to inform us of their understanding of the core texts of their traditions. It is hard enough to discern who among those representatives comes closest to the historical understanding that is being handed down, and without written sources, that task would be ever so much harder.

Unlike science, for which there are plenty of introductory books, popular as well as professional, I am not aware of similarly comprehensive books for contemplation in its generality, beyond the confines of specific traditions. In addition to the challenge of integrating science and contemplation, we thus face the preliminary challenge of finding an integrated description of core aspects of contemplation across traditions. Since this is too daunting a task, within the scope of this book, the best and most authentic I can do here is to present a brief sketch of my own research activities in this area.

the start of a personal journey

When I started to explore the mind, toward the end of high school, I learned to meditate according to various traditions, mostly through Hindu and Buddhist methods, especially Advaita Vedanta and Zen, but before long I also discovered Medieval Christian approaches that resonated more with my Dutch upbringing. As an undergraduate, I attended Zen retreats but also took part in weekly seminars about the Flemish mystic Ruysbroeck. I spent part of my summer vacation at a Trappist monastery one year and a more mainstream Benedictine monastery another year.

A decade later I became acquainted with Tibetan forms of Buddhism and was specially intrigued by Tarthang Tulku's book "Space, Time & Knowledge", which of all the books I have read comes closest to presenting Buddhist inspired insights about the nature of reality in scientific terms. Attending some of the workshops at his center in Berkeley, starting in 1980, helped me get a more hands-on understanding during the next decade.

By 1989, I had reached a modest level of experiential understanding of the various non-duality traditions that had inspired me most. That year was a watershed for me, when I met some Dzogchen teachers who represented the contemplative milieu that had inspired Tarthang Tulku. It was at a workshop in Japan, where Namkhai Norbu gave a pointing-out instruction to the nature of mind, that my intuition and insight ripened into a more direct realization of what it could mean to transcend subject and object.

From then on, while my experiential understanding grew further, I voraciously read further in books from different traditions, for a while focusing on Medieval Christianity and Sufism, then moving back again to Buddhism and Taoism. In parallel I studied Husserlian phenomenology and attended conferences in that area, where I gave some talks about my budding understanding of the way that Husserl could provide stepping stones to connect science and contemplation.

the continuation of a personal journey

Seven years later I met Steven Tainer, who had written Tarthang Tulku's book "Space, Time & Knowledge" on his behalf, based on a lengthy collaboration involving many interviews and discussions. Steven was in the unique position of being trained in mathematical logic and philosophy of science, before starting on a dual career in information technology companies and in philosophy. In his first capacity, he worked for Silicon Valley firms for over twenty years. In the second, he has studied many living traditions from India, Tibet, and China, and written on various aspects of these traditions for several Asian teachers since 1970.

His current activity includes a regular teaching schedule for his own groups of students, weekly public classes at the Berkeley Buddhist Monastery, and leading retreats of various lengths. He frequently visits my Program in Interdisciplinary Studies at the Institute for Advanced Study in Princeton.

After meeting Steven, he and I quickly started working together to further explore in a wider context the ideas presented first in "Space, Time & Knowledge", and we have continued to do so for well over two decades. All together, it has taken me almost half a century to reach a point where I now feel qualified to write from my own experience, using my own voice, about my understanding of how a future science-contemplation unification may come about.

a non-personal journey

For simplicity, I have written the above two vignettes as if there was a person, Piet, who looked around, struggled, and reached some insights. However, such an account gives a very limited and rather misleading account of what was going on.

A core insight of subject/object non-duality is that there are no isolated subjects that can be meaningfully cut out of the interwoven fabric of relationships that define any situation. That notion, while convenient for every-day linguistic purposes, is ultimately a fiction, and evaporates upon further investigation. Whether the resulting insight is then labeled as a discovery of 'no-self' or 'higher self' or 'the Tao' or 'God as the Ground of my ground', etc., is less important.

So a more accurate rewrite of the above brief history of my explorations would drop the 'my' as a reference to an implied continuous entity to whom this and that happened.

a non-personal non-journey

However, dropping the usual emphasis on a self to whom this or that happens, is only part of the remedy to the above story. Another correction has to be made to the idea that there was a journey involved. Strange as it may sound, dropping the notion of a self also entails dropping the notion of time.

In a picture in which time takes the form of a linear, one-dimensional past-present-future sequence, it is natural for there to be cause and effect, events triggered by other events, and agents doing the triggering. But when the existence of the self, and of agents in general, is being called into question, by implication the nature of time as we know it is called into question as well.

Timelessness at first seems to be even more mysterious than the absence of a self. And both are totally mysterious from the point of view of common sense. Selflessness, as we use the word normally, is very different from a no-self picture. Someone who acts in a selfless way is likely to still have a particular sense of self, namely one who acts in service to others. To view time and self as conceptual constructs that don't correspond to reality are more radical steps than just about anything else one can imagine. We will explore these notions in much further depth in Part III.

exploring timelessness

One way to get a glimpse of a sense of timelessness is to practice dropping a few other things first before attempting to drop time. Here are a few hints for a playful approach to this kind of exploration in five steps. You can take a few minutes for each step, or you can make the steps shorter or longer, as you like. There is no reason to push or try hard. Just consider it as a fun game to play!

Step zero. This is not really a step since it amounts to just sitting in a comfortable position and becoming aware of your status as a person, with all that that entails. You have a specific personal history, you have a rather well defined personality that others are familiar with, and you are alive, being subject to time that propels you from your past toward your future.

Step one. Now imagine dropping your personal history. You can do this in many ways. For example, you could imagine a process like waking up from a dream, where you realize that what you had taken for granted in the dream suddenly drops away, only to become a distant memory. How does it feel to imagine dropping your personal history? To what extent does it feel like a loss, leaving you perhaps somewhat disoriented? And to what extent does it feel like a gain, a newly found freedom from the momentum and strictures of the past?

Stage two. Next imagine dropping your personality. You can ask yourself similar questions as in stage one. Does this feel like an impoverishment, perhaps making you less sure of yourself as to how to react to changing circumstances? Or does it feel more liberating, opening up new ways to respond to the world and to others, beyond what you have experienced so far? Or perhaps both? To what extent does it destabilize you, and to what extent does it allow you to be more agile, more able to 'turn on a dime'?

Stage three. Without personal history and without a pronounced personality, you are still a living being, an at least semi-autonomous agent among other agents and objects in the world. Now try to drop the notion of being alive. Again, the example of a dream may be helpful. Within a dream, if you happen to realize that you are dreaming, it can become clear that there is no real distinction between you and others around you who are alive -- whether humans, animals, or plants -- or inanimate objects that are not. All are equally creations by your dreaming mind. Similarly imagine how it would be to drop the special status of you as a living actor in a mostly inanimate world. Is there a sense of freedom akin to waking up within a dream? Does it perhaps come with a re-enchantment of the world as in a fairy tale?

Stage four. Finally, imagine that you can drop time, in addition to the other characteristics that set you apart from your surroundings, like being alive and having personal attributes like a unique character and history. This may be more difficult to do, but the explorations in the previous chapters may provide some inspiration. This challenge goes one step beyond walking into a movie theater and watching a movie or entering a virtual reality. In those cases, the space you find yourself in is not real, but the time elapses at a normal rate, at least in between jumps, and is as real as before you entered. Now ask yourself, what would it be like if not only space were virtual but also time? Can you 'wrap your mind around' a 4D virtual reality, instead of the usual 3D virtual reality?

* * *

Part III. The Challenge of Integration

Chapter 11. The Mind-World Circle

We are now approaching the mid point of our journey through the landscape of science and contemplation. In Part I of this book, we looked at past and future of science. There was little need to introduce the idea of science, something everyone in our culture is familiar with. In Part II we switched our attention to contemplation via an introduction through modern philosophy, in the form of phenomenology. We are now ready to see how the two, as studies of matter and mind, can fit together.

This Part and the next will take different approaches. In Part III we focus on ways to start an integration of both types of studies, something that is clearly needed. In contrast, Part IV will begin to explore the possibility of something much more challenging: a real form of unification of our so far partial understandings of matter and mind. Whether such a real unification is even possible is an open question, where I am using the qualifier 'real' to indicate something that goes beyond attempts to reduce mind to matter or the other way around.

integration and unification

To illustrate the difference between integration and unification, let us return to the example we saw in Chapter 3 of relating two seemingly quite different phenomena, water and ice. While ice and water behave very differently, they are clearly related. The fact that simple acts like heating ice or cooling water can transform them into each other already hints at the possibility of an integrated treatment.

Since the same 'stuff' can show up in either form, it is tempting to speculate about a microscopic mechanism that might explain the transformations between water and ice. Indeed, philosophers in Greece and India conceived of various models for the existence of atoms, as the smallest indivisible particles of matter that could then be invoked to explain the behavior of matter in bulk. However, they did so in a different way from how we do it now: they considered air, water, and earth to be different atomic elements, whereas we have discovered that the difference between a fluid and a solid stems from *different configurations* of the *same molecules*, namely H_20.

The first scientific theory of atoms was proposed by Dalton, around 1800, on chemical grounds. Einstein, a hundred years later, argued for the existence of atoms on physical grounds, based on Brownian motion. During the twentieth century, increasingly sophisticated models were proposed for phase transitions, as physicists call phenomena such as melting and freezing.

Surprisingly, it was only recently, less than fifty years ago in the nineteen seventies, that finally a true unification was achieved through the work of Ken Wilson. He was the first to show how the phenomena of phase transitions could be calculated from first principles, rather than by constructing plausible models that fit the observations to some degree of approximation.

the integrated nature of mind and world

Compared to ice and water, where the separate appearances of each are clearly connected and integrated by the potential to transform into each other, mind and world are even more obviously integrated. Each time physicists do any experiment or work on any theory, they use their mind. No study of the world could take place without a mind studying it. And conversely, each physicist has a body and moves around in the world which he or she studies.

Anything we know about the world stems from the way the world appears within our consciousness. And conversely, our consciousness appears in the world in connection with our bodies that are located in the world. Mind and world form an intimate circle.

We can choose to focus on the world part of the circle and call ourselves physicists. Or we can choose to study the mind part, calling ourselves psychologists. But whatever we do, as long as we are alive in this world, we are dealing with a mind-world circle, in everyday life as well as in our various professions.

a tower or a bridge?

At the start of Part II, in Chapter 6, we considered explanations in terms of towers and bridges. It is fair to say that most neuroscientists, and most natural scientists in general, consider the mind to be a product of the brain. In that picture the relationship is that of a tower. The material body, at the bottom, is what grounds everything, with the mind coming in at a higher floor, as a derived quality, an emergent property. No circles here at the most basic level of explanation.

The only problem with this urge to ground a more complex phenomenon as emerging from a dance involving simpler building blocks is that there seems to be a glaring gap. At which point, and in which way, does first-person experience get triggered by electrical and chemical reactions in matter, described so well by third-person based theories? How does a dance of molecules produce a thought or a feeling? This old philosophical question was rebranded and popularized for contemporary scientists by David Chalmers with the provocative name, 'the hard problem of consciousness'.

But what would be the alternative? Can we even conceive of a type of scientific picture that would include both matter and mind on equal footing, as forming a bridge,

ready to then be unified in the construction of a higher level theory?

We can.

In the next few chapters I will sketch some possible approaches as examples to show that tower based thinking is not necessarily the only game in town.

But before doing so, let me add a few words about the way new approaches are introduced and published these days in the scientific literature.

obstacles against radically new approaches

The current fashion in science is to not publish any new ideas as such. That would be considered speculation, left to armchair philosophers, as many scientists would say. Instead, a new idea typically is illustrated with a model, preferably a computer simulation. No matter how questionable the correspondence between the new idea and the simulation may be, or even whether or not the simulation has been programmed and run and interpreted correctly, as long as there are some graphs and other quantitative output, a scientist has license to publish a new idea.

By itself this is a good idea to prevent wild speculation and to exert some needed quality control. But as so often is the case, here the pendulum has swung way too far in my opinion. I have come across countless papers that asked very pertinent questions about the nature of consciousness and proposed some potentially interesting ideas but then added some terribly oversimplified and frankly almost silly model to fulfill the expectations of their fellow scientists for a caricature show-and-tell.

It is a pity that the scientific literature has gotten caught in this kind of straitjacket. In the light of a deep problem, asking the right questions is absolutely essential and, in fact, more difficult than giving the right answers. The next best thing is pointing in a promising direction of where to look. It

is only when you have done the hard creative work of both questioning and pointing to a deeply satisfactory level, that it even makes sense to look for a specific model.

Of course, if you can do all three that would be truly amazing -- more power to you! But if you can do 'only' one or two, and do that well, what a waste it would be to let peer review prevent your ideas from being published, until you add some marginally relevant and often half-baked computer model for good measure? Alas, that is what currently happens, and that is the reason that I have waited for decades until writing my ideas here in a the form of a book, rather than in stand-alone articles.

And still, here in this book you won't find any models, let alone computer simulations. This may strike my colleagues as surprising given that my main research has been in large-scale astrophysics simulations. The Barnes-Hut algorithm, that Josh Barnes and I are most known for has gathered well over four thousand citations and is used widely in simulations of the dynamics of stars as well as molecules. It would be very easy for me to cook up some model in which to use that algorithm, ask for some time on the latest supercomputer, and present some razzle-dazzle 'demonstration' of a new model for mind-world interaction. If only fundamental progress in science were that easy!

life as a dream

In Part I we have playfully explored aspects of the subject/object relationship, something we use in almost every waking moment of our lives, and even in our dreams, but typically without questioning or investigative tinkering.

In Part II we moved on to play with the nature of time, questioning the past-present-future structure of time as culturally received during our upbringing, and rarely if at all, questioned to any extent.

Now that we enter Part III, let us extend the notion of play to see in how far we can take the best of two worlds we are familiar with, the world of waking and the world of dreaming.

Usually, while we are dreaming, we don't realize that we are in the middle of a dream until we wake up. However, it is possible to realize the dream nature of a dream while you are still dreaming. This phenomenon is called lucid dreaming, a term introduced more than a century ago by the Dutch psychiatrist and literary author Frederik van Eeden.

Some people can't remember ever having had a lucid dream, others occasionally dream lucidly, while yet others do so regularly. But even if you've never experienced a lucid dream, it may not be that hard to learn to do so.

The best recipe seems to be to ask yourself regularly "am I dreaming?" When you do so, your immediate reaction is to say "No, of course not". Even if you form the habit of asking that question while waking, and then ask the question in a dream, you are likely to also give the same answer. Therefore, it is good to test your answer.

There are various ways. One is to make a very slight jump, small enough not to startle people around you in case you are awake, and see whether you fall down or stay aloft. Another is to look at your watch, or try to read a piece of text. When you try to do so in a dream, the numbers or letters tend to swim together and lose their coherency.

You can extend these investigations to have fun while imagining that your waking life is dream like. If you don't cross the street, thinking that dream cars won't hurt you, and refrain from jumping out of windows and the like, you can build up more familiarity with the dream state, and lower the habitual barriers between the two main modes in which we use our conscious experience of being actors in situations.

How about doing all this for a while, to prepare for further, more detailed explorations?

* * *

Chapter 12. Panpsychism and Panmaterialism

So far, it is hard to quibble with the description of our life as playing out in a mind-world circle as long as it is seen as only a description of what we encounter. In philosophical terms, as an epistemology, the circular nature of the relationship between mind and world is hard to argue with. But that does not imply that mind and world are both equally part of reality. In other words, the ontology of reality may well be very different.

In fact, scientists tend to see it as a given that there is a world composed of processes involving matter and energy in a vast arena of space and time and that everything else, including what we call mind and any conscious phenomena, are all layered on top of such physical processes. The only question, in that way of thinking, is how exactly consciousness emerges out of brains and other aspects of physical bodies.

panpsychism lost

Interestingly, an alternative to the view described above is slowly making its way into the mainstream of scientific thinking, as a remote possibility for now but something that at least some leading scientists are beginning to take seriously. This is the idea that consciousness is equally as fundamental as matter, and that our reality is composed of a mixture or combination of both in some way.

The philosophical term for such a view is loosely called panpsychism, and it can come in many variations, some of which go back thousands of years, at least among Greek and Indian philosophers. Variations of these views remained popular until quite recently, even early into the twentieth century.

However, for several decades in the middle of the twentieth century, panpsychism almost disappeared from

the intellectual horizon, partly because of the enormous success of science. The shining light of physics in particular had a blinding effect on all other ways of looking at the world. Its dazzling array of new technologies, including most prominently nuclear weapons and nuclear power plants, seemed to leave little doubt that physicists finally had managed to understand the nature of reality deeper than anyone before them. Sheer power was seen as a sign of deep understanding, to the exclusion or at least deprecation of other ways of knowing.

panpsychism found again

There was a rebirth of panpsychism in the latter part of the twentieth century. I welcomed this resurgence as a healthy antidote to the narrow thinking that I encountered as a beginning student, which had stymied my enthusiasm to share my own views with others, back in the early seventies.

At the same time, the versions of panpsychism I came across did not strike me as very well defined, not very attractive, or both. To make sure to give panpsychism its due, just now I looked it up in the Stanford Encyclopedia of Philosophy, the best on-line handbook I know for quick yet in-depth discussions of philosophical problems and orientations.

To my pleasant surprise, I saw toward the end of the first section "Panpsychism in the History of Western Philosophy", a mention of the paper that the cognitive psychologist Roger Shepard and I had written in 1997. I had no idea that our thinking had already entered the history of Western philosophy. (^_^)

The word count of the 2017 version of the article on panpsychism that I consulted was about 15,000, close to a third of the size of this book, so there is no way that I can adequately begin to enumerate the various versions that have been proposed from antiquity to the present. What is

more, the article completely neglected Eastern philosophy, even though the title was simply "panpsychism".

Clearly, a truly global article of the same depth would probably be as long as the book that you are currently reading. I wonder how long it will take for colonialism to finally wear off! I hope, but doubt, that I will live to see the day that philosophy departments in universities will either change their name to “European Philosophy”, or vastly broaden their area of study to include Persian, Indian, Chinese, Tibetan and Japanese sources, to name a few.

panmaterialism

The main problem with panpsychism is that it typically doesn't go far enough. Most versions of panpsychism that I have encountered posit aspects of mind or consciousness to accompany the presence of matter situated in the familiar world of space and time. In that way, we start with matter, use space and time as the arena in which material processes take place, and then add a mental component for good measure to cover up a blatant gap in our inventory.

This kind of panpsychism resembles a tent, held up by the tent poles of space and time in a typical materialistic world view. The main novelty is that it is a double layer tent, with a mental layer added on top of a material layer, but otherwise situated in the same terrain as what science offers us. While perfect for camping in the rain, it leaves something to be desired for a world view.

Such panpsychism, supported by panmaterialism, still gives the impression of icing on the cake. It portrays the mind as a second-class citizen, an immigrant in a world already staked out by matter. It should be possible to do better than that.

a couple alternative approaches

As I mentioned in the previous chapter, I am hesitant to seriously propose any particular model as an alternative to the current trend in panpsychist approaches. I think it is too early to do so, and I don't want to just speculate. On the other hand, it may be fun to come up with several ideas as a way to flex our mental muscles and widen our horizon of imagination. In this spirit, I sketch two approaches that go beyond the usual panpsychist suggestions and are new as far as I know. If not, I look forward to stand corrected. Both approaches provide ideas that are more symmetric in the treatment of mind and matter.

The first one invokes a form of spontaneous symmetry breaking, a device used in condensed matter physics as well as in elementary particle physics. Designed to model situations where an underlying symmetry is present but hidden, it could be naturally adapted to a model in which mind and matter are more symmetric than is currently obvious. I sketch this one in the next chapter.

The chapter following that one goes one step further, and considers the possibility of a mental meta dimension to the fabric of our world in addition to space and time. In that picture, notions such as depth of insight may acquire more than metaphorical meaning. Rather than layering mind on top of matter, as in panpsychism, cognition would be part of a space-time-awareness continuum, of which spacetime forms a projection, comparable to the way space and time can be seen as projections of spacetime.

lucid living

In the previous chapter, the idea of lucid dreaming was introduced together with a few suggestions as to how to learn to become lucid enough to recognize you are dreaming. In addition, the suggestion was made to explore dream-like qualities within your waking life. I suggest you

continue to invite lucid dreaming to occur and, at the same time, explore lucid aspects of the waking state.

One example of the latter is to observe your own tendencies to sometimes get frustrated. Most likely, you won't have to wait very long to encounter a situation, any situation, in which you feel at least a little annoyed at something. When that occurs, you are in luck, since it will present a great opportunity to explore lucid waking.

After watching your own response to a frustrating situation, see whether you can choose to see the same situation in a more cheerful light. In a lucid dream, you can choose to fly, rather than to walk, which is a lot more fun than walking. In a lucid waking episode, how about choosing to be cheerful rather than annoyed in a frustrating situation? That may well be more fun too!

It may not be easy to do so after perhaps a lifelong habit of being not so cheerful when frustrated. You can take your time, starting with only marginally frustrating situations, such as just missing a stoplight and having to wait half a minute or more before moving on. Like taking on weight lifting, you can begin with something that is rather easy to lift and gradually push your limits.

Whenever you remember to "fly" beyond your habitual pattern of walking, in the light of modest frustrations, try a more fun type of response and see how it feels. Enjoy the exploration, and see whether it brings more awareness to the way that every situation is pervaded by physical and mental aspects, always offering more choices when we inspect a situation more carefully.

* * *

Chapter 13. Spontaneous Symmetry Breaking

Neuroscience is making great strides in clarifying the relationship between the physical processes occurring in our brain and the conscious experiences we have that are clearly correlated with those physical processes. Enormous resources are dedicated to research in this area. One measure of the ongoing activities is the typical number of participants in recent yearly conferences of the Society for Neuroscience in the US: around 30,000 with about 25,000 of them active researchers.

Imagine a fairly large city where every typical working adult is a neuroscientist, in addition to a minimum population of other professionals needed to keep the city running, and you will get an idea of the world wide population of people studying the brain and its nervous system. Virtually all their work is going into a refinement of models where material properties and processes govern the type of experiences we have. But what if these models are incomplete?

In this chapter I propose a different type of model for the relationship between matter and mind, based on an analogy with the relationship between electricity and magnetism. I'm not implying that I take this type of model seriously, and I do not intend to work it out in any great detail. Rather, my aim is to tell a cautionary tale, to warn against jumping to the conclusion that the standard reductionist way must be the only game in town, by showing that panpsychism can be pushed a bit further than it seems to have been done so far.

Maxwell's equations

One of the triumphs of nineteenth century physics was the discovery by the Scottish scientist James Clerk Maxwell that electricity and magnetism can be described by a single unified theory, electromagnetism, in which electricity and magnetism behave similarly in the absence of electric charges. His equations showed him that this particular

symmetry implied that light is in fact an electromagnetic phenomenon in the form of waves with symmetric electric and magnetic field components.

This was all completely unexpected since until then electricity and magnetism had been considered as related but very different phenomena. Most importantly, in nature there are electric charges, positive and negative, but there are no magnetic charges. Any magnet comes with its magnetic poles in pairs, a south pole for every north pole, and vice versa.

In general, when electric charges are moved around in an oscillatory way, electromagnetic fields are produced. This is how radio waves are created, by moving electrons up and down in antennas that transmit the waves to other antennas that can then decode them from the pattern of motions of their electrons, moving up and down at their receiving end in response. Electromagnetic radiation at higher frequencies show up as light, and for even faster oscillations as X rays and gamma rays.

broken symmetry

Before Maxwell, it seemed that electricity was a primary phenomenon that could occur by itself. A single positively charged particle can just sit there by itself with its electric field spread around it in all directions, attracting negative charges and repelling other positive charges. This resembles the way in which a massive object exerts its gravitational force on other massive objects -- whether the Earth, the Moon, or an apple -- the difference being that gravitational forces are always attractive.

Magnetism, as we just saw, seemed like a derived phenomenon. Nobody had ever seen an isolated magnetic charge, neither an isolated magnetic north pole nor an isolated magnetic south pole. As yet, nobody has seen such a thing, though physicists do have a name for it: they call it a magnetic monopole, in contrast to ordinary magnets,

which are called dipoles because they always have two poles.

While musing about the notion of panpsychism, I found it quite striking that electricity and magnetism have a relationship to each other that parallels in some way the relationship between matter and mind. Matter is found in nature all by itself, while minds seem to be dependent on a material substrate, just as electric charges are found in nature, while magnetic phenomena seem to be derived from electricity.

Minds seem to need particular processes in specific configurations of matter to be produced and sustained. Living and dying in this analogy then resembles presence and absence, respectively, of an electric current in the right dynamical configuration to induce a magnetic field.

beyond panmagnetism

What this analogy suggests is that the seeming asymmetry between matter and mind may actually be a case of a broken symmetry. In electromagnetism, the symmetry of the equations is broken through the one-sided appearance of charges: only electric ones, not magnetic ones. It is at least possible that something similar is the case with the relationship between matter and mind.

If there is anything to this analogy, it tells us that recent suggestions of panpsychism may be too tame. Maxwell did not invent a theory of panmagnetism; he did not start out by postulating that every charged particle hides a bit of rudimentary magnetism inside (note for aficionados: actually electrons and quarks do carry magnetic moments but that's besides the point here, with pun intended for point particles). Instead, Maxwell's theory unified electricity and magnetism, rather than smuggling the presence of one inside the presence of the other.

Similarly, my best guess, again conservatively speaking, is that a future theory of mind and matter will go much further in its unification than any current proposal of panpsychism that I have seen. Instead of smuggling a little bit of consciousness inside each bit of matter, it seems to me more likely, and certainly more symmetric, to separate the question of the constitution of matter from the phenomena presented by material and mental processes, phenomena that may be waiting to be unified.

possible implications, over drinks

I want to emphasize, once again, that I am not offering a theory of consciousness based on magnetism. That was tried already in many forms more than a hundred years ago, and expressions like 'a magnetic personality' stem from those attempts. In fact, a few thousand years ago Thales of Miletus proposed that magnets were conscious. It sure is hard to be original in philosophy!

Rather, my main aim is to inject a cautionary note into discussions about how and why mind seems to be causally dependent on matter. It may not be, as the above example shows.

It would be fun, though, to speculate what would be the consequences if this analogy would turn out to have any merit aside from being a cautionary tale. Physicists by and large love to stretch their models and analogies over drinks, and I am one of them.

For one thing, magnetic monopoles may well be found one day. There are many millions of dollars being spent in serious searches for such monopoles in the form of cosmic rays that may have been produced very soon after the big bang when conditions may have been still right to produce them. By a strict analogy, isolated minds under the right circumstances could then be expected to produce matter, as a kind of 'reverse brain', if brains indeed produce minds.

For another, even without mental monopoles ('monominds' or more elementary 'monomindlets'), there still might be phenomena analogous to that of light in electromagnetism, present even in the absence of either mind or matter. Who knows what a future unified theory of mind and matter would present us with? Could something exist that would be neither mind nor matter, but that could influence both – just like electromagnetic waves that can propagate in a vacuum without the presence of electric or magnetic charges?

We simply can't know until such a theory is constructed, just like Maxwell couldn't possibly know that light would fall out of his equations until he derived them -- with his derivation based on arguments that had nothing whatsoever to do with light. So all we can do at this point is have another drink and speculate a bit more about possible consequences of analogies that are only meant as illustrations. (^_^)

dream on

This may be a good point in this chapter to give the advice 'dream on', not only to further speculations but also to the next step in our explorations of parallels and overlap between dreaming and waking.

Let us continue the adventures suggested in the previous two chapters. In the first one, the idea was to regularly check whether you are dreaming, so as to make that a habit that may then kick in both while waking and while dreaming. And if that happens while dreaming, it may lead to realizing that you are dreaming, which means entering a state of lucid dreaming, opening the door for lots of fun.

In the second one, the idea was to explore lucid waking as a parallel to lucid dreaming. In a lucid dream you can decide to fly if walking gets too boring. And in lucid waking you can decide not to react in frustration if doing so becomes too boring. And indeed, it is far more interesting to

learn to respond rather than to react to what is going on around you.

Note the etymology of the two words. When re-acting, you go on automatic pilot, repeating an action. That is quite different from re-sponding, with the current meaning 'answering', but with the original Latin root 'spondere', meaning to offer. Offering someone a fresh gesture or phrase is surely a lot nicer than just reacting!

However, this is easier said than done. Learning not to get frustrated by waiting for traffic lights is already hard enough for quite a few people. And learning not to react when somebody pushes your buttons turns out to be quite a challenge for most of us, myself included.

Not reacting doesn't mean being stoic and letting things just happen, good or bad, pleasant or unpleasant. Rather, refusing to react *as an automatic habit* opens up the possibility to respond, as a conscious act, tailored to the situation.

The possibilities for responding are endless. Rather than sniping back if someone snipes at you, you may just listen a bit more to see where someone is coming from, you may offer a mild apology if there is something you could have done better, or perhaps a friendly smile could be the most appropriate, as long as it wouldn't likely be interpreted as condescending.

For now at least, how about the following exploration of re-acting versus re-sponding. Without trying too hard to change habits, we can just notice after the fact when we fall into a habitual reaction. Waking up to a lucid life would be great but let's take it easy for now. Dreaming on for a while longer, on autopilot, is not such a bad thing as long as we notice what is happening. We can then analyze the situation later on, after the fact, while preparing for more lucidity to shine through in our lives.

One easy way is to keep a journal. For example, before going to bed, if you are like me, it will be easy to remember at least one instance where you could have re-sponded better, offering a nicer form of reply than a re-action. As a footnote: re-ply comes from the Latin re-plicare, where plicare means folding: a reply or replication implies a re-folding, somewhere in between re-acting and re-offering.

Jotting down one such instance a day and rereading the one from the last few days (or, say, from ten days ago), altogether won't take you more than a few minutes, less than brushing your teeth. It might be a interesting way to use your life as a lab, actually using your mind to explore your mind -- for fun and profit, as the saying goes.

* * *

Chapter 14. A Mental Meta Dimension

In the previous chapter we saw how in physics a lot can be going on in a field without sources. In a typical room we will normally not find specific electric charges, nor obvious magnets lying around. But any room we find ourselves in nowadays contains an incredible amount of information, imprinted on the electromagnetic waves that pass through the room, ready to picked up by suitable antennas.

A myriad cell phone conversations, as well as radio and television programs and other broadcasts all ripple through seemingly empty space. It seems like a miracle that an empty room can contain so much information, and equally like a miracle that we can so easily pick out of that ocean full of crisscrossing waves that part of the information that we are interested in, the voice of a loved one, for example.

magic

Arthur C. Clarke summed it up in a pithy way, as "Any sufficiently advanced technology is indistinguishable from magic." And it goes both ways. While we know that cell phones work, it still seems like magic until we get some understanding of the processes that make it possible. On the other hand, we have no idea how material processes in the brain are correlated with personal experience, so that correlation effectively still lies in the realm of pure magic, even though we use it, or perhaps more properly are it, or at least identify with it, each moment of our waking life.

How can we hope to get a deeper understanding of this correlation, including the open question of whether or not it is a causation, our brain causing experience in some way? In the previous chapter, the idea of panpsychism was pushed a bit further than usual, just to illustrate the enormous space of possibilities to speculate in. In this chapter I will offer an even more radical extension of the 'pan', the 'all' in panpsychism, not only beyond the usual ‘all

matter partaking in consciousness', or even the idea of 'empty space partaking in consciousness', in the 'no sources' model mentioned in the previous chapter.

Here I will take my cue from another piece of magic that we encounter every day: the presence of space and time. Isn't it amazing that something non-material like space determines how matter can be packed together, how it can move and how it can interact with other forms of matter? And isn't it equally amazing how time determines all that happens with matter, time itself not being material either?

It may be that a future theory of physics can explain how space and time are able to display their magic tricks. Already some of the first steps were taken by Einstein, first in his special theory of relativity, in which space and time were partly unified into spacetime, and then in his general theory of relativity, a bit more than a century ago. As John Wheeler, one of the greatest educators in the history of physics, summed it up so nicely, "spacetime tells matter how to move; matter tells spacetime how to curve."

But for now, without access to such a future theory, we are still in the dark as to how exactly space and time, or something more fundamental underlying space and time, govern the realm of physical processes. Even so, we might already find a clue here, in trying to understand the magic of brains thinking thoughts and feeling emotions: it may be somewhat akin to the magic displayed by space and time.

a parable: living in space land

For starters, let us take the mystery of space and time, and see whether we can make headway in a divide and conquer approach. Let us imagine a country with a culture in which everybody knows what space is, but there is no term for time. People of course know about motion and change, but somehow they have no embedding notion of time as that what enables processes to occur.

Now imagine what might happen if you were to visit such a country. After finding out that time is not a known concept, you might try to explain to them what our notion of time means, and why and how we use it.

Perhaps you would draw a few pictures, or even simpler, take a few photographs as snapshots of the scene around you. You could then point to these snapshots and explain that it is time that allows for changes and thus allows each picture to be different.

A natural reaction would be: "do you mean that a car has a lot of time, a cloud less so, and a building no time to speak of?" Taking the amount of change as a measure for the amount of time inherent within an object would treat time as a material something, located in a place and having the power to do something. But natural as it would be, it would be totally wrong.

How to explain that time is the condition of possibility for change to occur? And then to convince the people there that 'condition of possibility' is not just a fancy academic term but, in fact, is what makes time so important? How to explain that it is the potentiality of time that makes it at least as real as the actuality of the presence of material objects? This may not be easy . . .

living in spacetime land

Now imagine a variation on the above parable. A few aliens land on Earth, and get in a conversation with us about our understanding of the natural world. For a while we all get along fine, as long as we compare notes about physics and chemistry and the material properties of living cells and the like. Excitement builds up on both sides, seeing how much can be shared between the knowledge that has been acquired in the alien civilization and in ours.

But then, unexpectedly and suddenly, the conversation is grinding to a halt. When talking about cognition, the aliens

grow more and more puzzled. However, after a while the alien version of a light bulb lights up for them. They smile and they tell us that what we call cognition is merely pointing at specific acts of cognition, whether by humans, animals, machines, or in other ways. What the aliens mean, when they use the word cognition, is something altogether different.

For them, cognition is the condition of possibility for any acts of cognition to occur. When pressed, they describe it as something very real, part of the fabric of reality, but not material in any meaningful way. When the Earthlings press them further as to what the fabric of reality is like for them, they respond: well, you know, whatever is most basic, like space, or time or cognition.

By that time a more conventional metaphoric light bulb lights up for the human interlocutors. They realize that for the aliens cognition is a meta dimension of reality, just like three-dimensional space, and just like one-dimensional time. Eagerly, they come up with a flood of questions.

How many dimensions does cognition have, 1 or 3 like time and space, respectively, or perhaps more? If space and time can be partly unified, while still retaining significant differences, into a 4-dimensional spacetime, would it be useful to talk about an n-dimensional space-time-cognition fabric of reality as the underlying arena in which everything else plays out? And so on.

living in space-time-awareness land

This second parable could be continued in many different ways with different answers given to the questions asked, leading to very different stories. But even more interestingly, let us imagine the following sequel.

Before the aliens could answer the many questions that the human scientists and philosophers brought to the table, one of the aliens had an "aha!" moment. He or she or it

called out "we got it wrong -- we should not have used their word 'cognition', but something else, perhaps 'awareness' or something else, less specific!"

Amazingly effective as their version of AI had been in translating human languages into their own and vice versa, the rare mistake that had crept in turned out to have contributed to the earlier confusion. Cognition is a term that is too much like motion in the first parable. Time is what allows motion to take place, but time can't be described as a ephemeral 'motion fluid' or 'motion aether' embedded in space, since that would reduce time to something in space, rather than another meta dimension, complementary to space. And neither can the alien's third meta dimension be translated with our word cognition: it is not a 'cognition aether' or anything like that, which would still be a material component embedded in space and time, with panpsychic overtones.

Putting the many questions that had come up to the side, the first order of business was to find a better term for the third meta dimension. Alas, after trying and discarding many options, the aliens were shaking their heads. Clearly, humans just didn't have the vocabulary yet to go beyond a physics-like understanding of the world as a complex dance of matter and energy in space and time. None of the terms offered seemed to enable a leap beyond, to describe phenomena like cognition and consciousness the way space and time went beyond location and motion.

As a way out, for the time being, a compromise was reached. Even though the word 'awareness' still had too much of an actuality ring to it, it seemed closer to being able to point to the potentiality of cognitive processes, as something one might grow aware of. Taking a break, at the end of their long first session, they unanimously agreed to use the word 'awareness' for the time being, in place of 'third meta dimension'.

awareness as intrinsic to reality

What I tried to convey in the second parable was a view of reality in which there is no duality between mind and matter in the way that Descartes pictured it. Rather, mind and matter play complementary roles, in offering complementary meta dimensions for the combined arena in which the cosmic drama plays out, with all its happenings, whether labeled sentient or not, and alive or not.

In mathematical terms, we could say that Descartes treats matter and mind as a sum, whereas the second parable treats it like a product. Where for Descartes matter has extension, like geometry has, but mind in itself doesn't partake in extension, in our picture everything in the world partakes in spatial extension, temporal succession, and some form of cognitive awareness. In Part IV we will come back to these suggestions, to explore more of their ramifications.

For now, I am offering the notion of meta dimensions as one more direction toward a possible integration of matter and mind. At the close of this Part, in the next chapter, I will address a simpler question, profound in its own right, concerning the relationship between matter and information, before moving on to discuss the more challenging notion of unification in Part IV.

A footnote here: I have published earlier versions of the meta dimension idea in various papers, including the 1997 paper with Roger Shepard that I mentioned two chapters ago, and a paper around the same time with the philosopher Bas van Fraassen. The name I tried then for the third meta dimension was 'sense'. The idea was that any act of cognition must make some kind of sense, using that word in a broad way. The original inspiration for the search of a meta dimension came from the book “Time, Space, and Knowledge” by Tarthang Tulku, mentioned in Chapter 10.

exploring space, time and awareness

When we dream, we encounter objects and other people within the dream space and dream time that provide the stage for anything to happen within the dream. We ascribe consciousness to our dream version of ourselves, as well as the dream versions of other people and animals we encounter. However, when we grow sufficiently lucid, or after we wake up, we realize that all this was given by and in our own mind which constructed the whole show, including dream versions of space, time, and all the imputed acts of cognition.

Another way to describe this is to say that a dream is like a tapestry woven from the fibers of dream space, dream time and dream awareness, sporting the patterns that appear in the dream, depicting things and people involved in situations and processes with events happening to them.

If you remember a recent, or not so recent, dream, see whether it makes some sense to view the dream, as you remember it, in that way. Alternatively, you can imagine a scene, as in a fantasy or a daydream, in which things happen, and try to view it as woven from fantasy space, fantasy time and fantasy awareness.

After having done one or both of those experiments, explore to what extent you can view the reality around you as a play in space, time, and awareness of some sort. There is no need to force any particular interpretation. You can just enjoy exploring how your thoughts and feelings, memories and anticipations could all be found to 'move' in a kind of awareness 'meta space', a play pen for acts of awareness, while also partaking in their own space and time embedding.

* * *

Chapter 15. Matter and Information

The existence of information in our world is a great mystery. Just because we are used to dealing with information doesn't make it less mysterious.

We can hold a chunk of matter in our hand, a hand that is itself also constituted of matter. But if we find a written instruction, or hear a spoken one, we can copy it, passing it on from one medium to another without diminishing it. When copied well, it remains the exact same information even while changing carrier. And unlike matter, information can be magically multiplied: copying a house takes a lot of work and skill, but copying a blueprint is trivial in comparison.

At any given time there needs to be a physical carrier, whether paper or stone or a human voice. Or it could be DNA, the codons of which encode the amino acid sequence for constructing a protein. Or perhaps a physical key, the shape of which contains the information that opens a lock. But in all these cases, the information contained in one of these carriers can be copied to a different medium, and then copied back again at a different place and time. Isn't that amazing? The world is full of wonder, right under our nose; or in our nose, in the case of DNA.

wonder

So far, we have focused on the relationship between mind and matter, starting with the deep understanding of matter that science has developed in the last few centuries. The way science portrays the world is as a dance of matter and energy in space and time, and the place and role of mind it is not clear in this way of portraying the world. But on a much simpler level, even the role of information is not yet clear, nor is the relation between matter and information. If there is a hard problem of consciousness, then underlying that is the hard problem of information.

Within the scientific picture of the history of the Universe, there are many points in time where novelty occurred, often surprising novelty. After the original glow of the Big Bang subsided, for a while there was only darkness, which astronomers call the 'dark ages'. This changed when the first stars were born and started to shine, reproducing locally bits of light that seemed to have disappeared forever while the whole Universe expanded and cooled and thus plunged into ubiquitous darkness. Soon after the first stars started to shine, rocky planets were born that circled stars of the next generation, after the first generation of stars had created heavier elements than the Big Bang had, needed to build planets. Soon rivers and mountains and clouds appeared on some of these planets.

The novelty of all that, after starting with glowing gas that was distributed in a very even way throughout the Universe after the first few seconds following the Big Bang, is just mind boggling. Given the rather simple equations that govern the behavior of matter, and the simple initial conditions that provided the starting point for those equations to play out, very early in the history of the Universe, who would have guessed the emergence of clouds and rivers less than a billion years later?

The world is full of wonder, on all scales, everywhere; and easy to see if and only if we don't take things for granted. If we look at anything as if for the first time, wonder opens up right there and then.

Wonders of the Universe

The Greeks made a list of the Seven Wonders of their world, as a kind of tourist guide, a must-see list for travelers. However, their world was limited largely to the Mediterranean and nearby regions, and the origin of their wonders spanned a mere few thousand years. During the last half century, we have explored and charted a much larger and much more complete terrain in space and time, for which to make a new and much improved tourist guide.

Our newly charted area is quite a bit larger than the Mediterranean world of the ancients, by a factor of a hundred quintillion (a hundred billion billion). It is the visible Universe, that part of the Universe from which light and other forms of radiation can have reached us, almost fourteen billion years old and with a current diameter of a little less than a hundred billion light years. It is a triumph of modern science that we know its size and age, and by and large its layout -- all from observations made in just the last few decades. So we are now in a position to extend the ancient list to a list of Wonders of the Universe.

My recommendation for such a list is rather small, containing only three main Wonders, but followed by much longer lists and sublists that contain marvelous wonders that are splendid in themselves, like stars and planets and rivers (like the rivers on Earth and on Titan). The Main Three, though, I consider Most Marvelous. I also like to call them Surprises, since each one can be considered as completely unexpected, utterly baffling surprises given what happened before.

Three Surprises

The first Surprise is the fact that there is anything at all. This is the Wonder of the Big Bang, with something originating from nothing. It is the wonder of the initial appearance of space and time, populated with many complex patterns of matter and energy, including stellar births and deaths, and planetary mountains and oceans, and everything else: in short, the wonder of the appearance of our Universe.

The second Surprise is the fact that some of the matter in the Universe became alive. Far more dramatic than gas clouds forming stars and planets and rivers is the fact that life on Earth appeared, and presumably in many other places in the Universe. Living organisms are able to evolve and grow in complexity, producing the vast ecological web

of the biosphere with its resilience and self-healing qualities in ways that nonliving matter can't.

The third Surprise is the fact that some of those forms of life became self-aware, and in doing so, developed the capacity to be surprised by these three Surprises. So far we are the only examples we know of organisms that can wonder about the existence of the Universe, of organisms, and of self-consciousness. But it would be rather provincial, on a cosmic scale, to think that we're the only ones around -- especially since we live in a planetary system that is less than five billion years old, with other planetary systems elsewhere having had a head start compared to us of at least seven billion years . . . .

the origin of information

The significance of the first Surprise is that it was the origin of matter and energy. The main significance of the second Surprise is that it was the origin of information.

Any living cell shares the presence of DNA as the oldest script on Earth encoding information. Before life arose, there was no system in place for coding and decoding information. Only afterwards did we develop the ability to describe non-living objects by measuring and then transmitting information about them. Had there been no life, there would have been no information. This may be a surprising conclusion given that we are so used to deal with information about non-living systems. It is easy to forget that any production and consumption of information in any effective way is done by and for living organisms.

In short, without living beings doing the measuring and describing, there would be no meaning to the notion of information, for any practical purpose; even apart from the fact that there would be no notion of purpose, and no notion of notion either. We, as living beings, can describe clouds and stars, but we don't assign to those any intrinsic purpose, nor do we think they have developed their own notions.

The first example of the use of information was the most primitive form of choice that living cells learned to make, between what around them could be considered food or not. Volcanoes don't choose to go off, nor do clouds use information to decide when to produce rain, but any life form does use information in some way or other. In that sense the origin of life is the origin of virtuality, the ability to use information coded in one form of matter -- for example, DNA -- to influence what it will do with other forms of matter, in the case of DNA by producing proteins that in turn govern processes such as metabolism and procreation.

the origin of minds

With the first Surprise being the origin of matter, and the second Surprise the origin of information, the third Surprise is the origin of minds. If we define cognition rather broadly as information processing, the possibility of making choices on the basis of available information, then the origin of life was also the origin of cognition. To decide what to eat, you need some rudimentary form of knowledge of what is edible.

Starting with what a simple cell 'knows', in that broad way of using the word knowing, there has been a gradual transition in degrees of complexity of cognition throughout the process of evolution of the biosphere on Earth, during the last four billion years. Yet, even though all indications are that it was a continuous process, it somehow produced the third Surprise, that of the emergence of minds, capable not only of awareness but also self-awareness and self-reflection.

Looking back on the three Surprises, we can see how each of them has unique aspects. Only the first one, at least as far as we now know, seems to have been a sudden occurrence as the name Bang suggests. The second one was more gradual with geochemistry leading to more and more complex organic molecules before biochemistry was realized in the first living cells. And the third Surprise, too, probably happened gradually with the emergence of greater

degrees of consciousness while animals evolved more complex forms of cognitive apparatus in terms of brains and nervous systems.

the origin of thinking in terms of origins

I could have made this chapter the first of this book, and when I put on my science hat, that would have been very natural indeed. The main reason for me not to do so is intellectual honesty. Yes, the story that science has uncovered is marvelous and solidly evidence based. The story is also very detailed and has been constructed very recently, during only the last few generations out of the more than ten thousand generations since Homo sapiens developed language, the basic tool to reflect and build on previous experience.

But is this tale of recent scientific discoveries the whole story? And if we pose this question, what story can we use, on the basis of which to construct a coherent answer to the question of the uniqueness of the story that science presents?

In mathematics, as in the court of law and in other human enterprises, it is generally much easier to give an existence proof compared to a uniqueness proof. For example, one particular coordinate system that is used for making a particular map may well guide tourists to the place they want to visit, doing that job splendidly. But that doesn't mean that there are no other maps, based on other coordinate systems, that can do a job as splendidly, or perhaps even more so, for a larger range of purposes.

The origin of our current thinking in terms of origins lies in the creation of modern science a few hundred years ago. During the millennia before that, a wide range of mythologies offered their own creation myths, different from culture to culture. Where they all wrong? Wrong with respect to which criteria? Or could at least some of them be pointing to aspects of the nature of reality that are not, or at

least not yet, fully recognized by the current state of science?

an open question

I consider the uniqueness of current scientific knowledge to be an open question. It is clear that scientific developments have been a very significant accomplishment of human beings, both in terms of cultural achievements and technological applications. And using scientific criteria, of course scientific results stand head and shoulder above all other types of results. But are those the only criteria to use?

Even within physics, our understanding of what is real has evolved dramatically over the last few hundred years. Gravitation has been described by Newton as a force between any two masses, by Einstein as the result of moving in a straight line in a curved spacetime, and it will in the future no doubt be described in yet a very different way, given that quantum theory and general relativity are still waiting to be unified. And while it is true that under every-day circumstances the results of calculations using these different theories will give almost exactly the same results, the underlying understanding of the nature of reality is very different.

Therefore, some future scientific theories may well be very different, and while reproducing what we know already, they may include totally surprising additional facts about the nature of reality, including phenomena we haven't dreamt of so far. And there is good reason to suspect that such additions will happen, in due time, and in surprising ways. A hundred years ago, physicists thought that they understood by and large how nature worked, but then quantum theory came out of nowhere, and changed our basic insight into how matter behaves completely. Who knows what else will be in store in another hundred years?

hubris and myopia

What should give us pause, is that there are still essential aspects of the human experience that are not, or at least not yet, covered in any meaningful way by science. Questions like value, as different from sheer facts, and questions like the meaning of responsibility, or beauty, or dignity, remain unanswered. The hope seems to be, for many scientists, that all that will one day fall out of a more detailed understanding of brains, but that hope is a very weak promissory note, which at least right now cannot be cashed in.

For these reasons, I am glad that the recent climate among scientists is increasingly allowing this question of the uniqueness of current scientific knowledge to be posed. Earlier in my career, most of what I heard around me were statements such as "Science says that x, y, z", often made by famous scientists. And I could not help wondering what this mythical beast called Science was, this anthropomorphic unicorn that could serve as an oracle to predict what all future science would have to offer, forever and ever.

After all, if science keeps growing, which is what scientists hope will happen, then future stages of scientific knowledge should be more accurate than the current one. In that case, how can scientists living today possibly channel the wisdom and insight of a future science, in proclaiming “Science tells us . . .”? Fortunately, that combination of hubris and myopia is now on the wane, or at least I hope so.

I will return to these questions in Part IV.

space and time of awareness

In the previous chapter, awareness was the name we chose for a possible meta dimension for cognition, just like space and time are meta dimensions for location and motion, respectively. How about exploring to what extent

you can find anything resembling a space of awareness, not only as a theoretical construct but also as something that may be experientially accessible in some way?

You can start by relaxing for a while, in any comfortable position of your choice, and then watch what arises at the surface of your mind. Anything will do, thoughts, feelings, sensations, memories, fantasies, whatever phenomena your mind presents. After a while, see whether there is anything there there that might qualify as a kind of mind space. Is there some sort of space offering 'room' for thoughts, etc., to show up in, take residence for a little while, and then leave again?

Alternatively, in the same exploration you can shift your attention to noticing the temporal aspect of this ongoing show. Try to observe how it is that all these fresh phenomena 'pop up' in your mind, stay for a bit, and disappear again. What is the nature of the time pervading your mind that is offering little slots for thoughts, etc., to enter the office hours of your attention?

To consider some kind of 'awareness space' may be more natural than considering an 'awareness time', or it may not be. The most important thing in any wide open exploration is to harbor no prejudice or expectation to what might occur and why and how, but rather just be patient, relax, and see what happens, even if at first it may seem that little or nothing is happening.

* * *

Part IV. Toward Unification

Chapter 16. Relating the Unrelated

Modern physics took off when Aristotle's barrier fell, his assigning different properties to the world above the orbit of the Moon and the world below it. Modern biology took off when the pre-Darwinian barrier fell, the perceived barrier between humans and other species.

These two breakthroughs, in the seventeenth and in the nineteenth century, respectively, opened the doors to whole new disciplines of scientific study. Physics was still called physics, and biology was still called biology, but that was more a matter of force of habit. In practice, each of those two fields were changed beyond recognition, each by relating two parts of reality that had seemed, till then, completely unrelated.

What remained in each case was no more than an approximate description of the most visible phenomena. On Earth, objects still tended to fall down, not up, and Linnaeus' classification scheme was still useful. However, the structure of the underlying theories, in physics and biology, and with them possibilities for further progress, were altered beyond recognition.

hard, harder, hardest

Research is hard work. Solving unsolved problems, in a world in which there are many scientists competing with each other, requires skill and persistence. And sometimes a problem simply cannot be solved with the methodology at hand. In such cases, the challenge to solve that problem is much harder, requiring a whole new technique to be invented in the process.

And then there are the hardest problems. These are even more difficult to solve because they require the recognition of there being an invisible barrier that blocks further progress. In the case of Newton and in the case of Darwin, the apparent separation between Heaven and Earth, and the apparent separation between humans and animals, were both very visible and were both accepted as a fact. What was invisible was that the seemingly insurmountable separations actually formed barriers that could be scaled. Or more accurately: they were only imaginary barriers, like lines in the sand, and all that was necessary was stepping over them, no mountaineering equipment needed. Sometimes the hardest turns out to be the easiest!

Once Newton asked himself the question of whether an apple falling from a tree, and the Moon falling around the Earth, might be subject to the same force of gravity, it was not difficult for him to realize that the same inverse square law applied to both: the gravitational force of attraction growing weaker as the square of the distance. And once Darwin asked himself whether the ability to breed plants and to breed animals could be extended over time to evolve new species and to thus connect humans and animals, it was not difficult for him to see the ramifications of that assumption.

challenging the unchallengeable

In both cases, the enormous challenge was to challenge what seemed unchallengeable. When everybody around you, including your most revered teachers, all of your colleagues, and all those who came before you firmly believe that something is off limits, and when they have developed what seems like rock solid arguments for their shared position, it becomes very hard, seemingly impossible, to explore the forbidden land.

Or more accurately speaking, it then seems that there simply is no land there to be explored. A sign in the park saying "don't feed the pigeons" means that feeding the

pigeons is off limits, but may attract those who dare to go against such restrictions. But there is no need to plant signs in parks saying "don't feed the unicorns".

Why are some ideas so hard to overcome? Why do they simply seem unchallengeable? In particular, why do some things appear unrelatable -- until somebody finds ways to relate them? The main reason to assume that two things cannot possibly be related, may be that there is no imaginable middle ground that could connect the two.

For the Greeks, trying to relate the supralunar world with the sublunar world didn't make logical sense. The supralunar world was obviously eternal and perfect, with any motion there continuing forever. The sublunar world, in contrast, was equally obviously very imperfect, with no motion ever seen to persist without something continuing to push it. How could they be connected? What missing link could be semi-perfect, semi-continuing?

The very idea seemed to defy logic. And for many Greeks, such an idea may have been a form of blasphemy as well, just like Darwin's ideas were for many a devout Christian, even today: the very idea of something that could be semi-human, semi-animal, stirs up awful images of monsters.

a beautiful example from mathematics

Trying to bring the heavenly realms down to Earth, or pointing out that humans may be descended from beasts, can easily get you in trouble. The nice thing about mathematics, as opposed to physics or biology, is that you can make a similarly unexpected revolution without anyone getting upset. Descartes did just that in 1637, as did Fermat independently at around the same time.

What they did was to relate geometry and algebra. I well remember how amazed I was, when on a nice summer day before the start of high school classes, I began to browse in

a book for my math classes that had just arrived, with the title "analytic geometry". Curious as to what that might mean, I opened the book, started reading, and just couldn't put the book down again. I was stunned by what I saw, and I was hooked for the next day and a half.

I had no idea that it was possible to translate between the language of geometry and the language of algebra, two subjects that I had enjoyed learning about. To my great surprise, analytic geometry showed me that it was possible for every line in a plane to write down an equation that uniquely corresponded to that line, and vice versa. It was one of the greatest 'aha!' moments of my high school days, that you could find the place where two lines crossed equally well by drawing the two lines as by solving an equation!

There was nothing that I could imagine that could possibly interpolate between a mathematical figure and a mathematical equation. Therefore, I had no expectation that two such different things as geometry and algebra could possibly be unified. But there it was, in front of my very eyes. Seeing it was for me a profound experience of great beauty.

can you say more?

It felt as if I walked into a room through one door, seeing two people playing chess, and then going out and entering again through another door, seeing the same two people playing checkers. No matter how often I would switch doors and thereby vantage points, the game would go on steadily, and at the end the same person would win or lose, from either viewpoint.

They played by two completely different sets of rules, but each of the two views showed a fully consistent game that corresponded move by move with the other view. Crazy, but there it was!

From then on, I learned to refrain from saying "you are wrong!" when somebody told me something that seemed totally different from what I saw, but rather to ask instead "can you say more?" And indeed, in many cases in the rest of my life, what initially seemed like a disagreement often turned out to be a different use of coordinates, labels, angles, or viewpoints.

the freedom that unification brings

Much later in my scientific career, I was vividly reminded at times of the power of the connections between geometry and algebra. Often there are two ways to derive a model of an astrophysical phenomenon or fit it to observational data. We can either use the equations that a model is based on or draw the graphs that illustrate the structure of the model, where the graphs correspond to the equations and vice versa.

The most vivid memory of such a later experience happened when I was more than twice the age at which I encountered analytic geometry. While discussing with a colleague what some of the properties of a particular globular cluster model would be, we could not agree about a way to solve the question we had. In the end, my algebraically minded colleague went to one side of the large blackboard in front of us, and started scribbling equations. Meanwhile, I went to the other side and started drawing figures.

Almost at the same time we reached a conclusion, and walking over to the middle of the blackboard, we were happy to see that we got the exact same answer. But a moment later each of us was surprised to see the other's derivation, looking nothing like our own, and derived in a way that the other would not have naturally thought about. This was for us a powerful example of unification, where two very different outlooks, each with its own language, can correspond to the same reality.

bridges can span water

In Chapter 6, two kinds of theories were compared, some like towers and some like bridges. In the tower model, one theory at the bottom can exist as is, stand-alone, while it can ground another theory that rests on it, as a derived theory, needing the bottom one for support. In the bridge model, two theories are like the two sides of a bridge, each one connected to the other, with the bridge forming a literally overarching theory that unifies both.

Analytic geometry is an example of such a bridge model, connecting algebra and geometry, without anything in between that would be semi-geometry or semi-algebra. To continue the metaphor, in between the two sides of the bridge is just water; there is no need for there to be an intermediate island in between, though of course there could be.

In contrast, the Newtonian and Darwinian model are neither tower models nor bridge models. The very classification in vogue before these two models were discovered was an artifact of prejudice. The barriers were not real. Above the Moon's orbit the very same laws of physics are in operation as below the Moon's orbit. And the origin of the human species is not different from the origin of any other species of animal or plant or other form of life, and the notion that species were immutable turned out to be just wrong.

A good metaphor for Newton's and Darwin's unification, in each case, is that of an island with a line drawn in the sand, somewhere in the middle, as already mentioned earlier in this chapter. Once the line is seen as just a line, it is easy to step over it, no jumps required.

Other examples of bridges

I suspect that in mature scientific theories, all forms of unified theories are of the bridge type. In contrast, the 'line

in the sand' types seem to occur in the transitions from pre-scientific to scientific theories.

With Newton, physics got a firm start, and unlike Aristotle's theories, Newton's classical mechanics is here to stay as the asymptotic theory that every future theory of gravity has to obey in the limit of low velocities, small gravitational fields, and macroscopic distances. It clearly works: it is what guided astronauts to the Moon.

With Darwinism, similarly, evolution was introduced, and it is here to stay, in some form or other, as an important element in any future theory of biology, whatever further additions and refinements will be discovered.

In mathematics, analytic geometry was a bridge theory because both algebra and geometry were already established and remained fields of importance in itself, and their unification only added deeper understanding to the way that they could be seen as parts of a larger whole.

In physics, too, electricity and magnetism remain valid in their respective domains, even when seen as two limiting cases of electromagnetism. Similarly, space and time remain different, even though to some extent they are unified in special relativity's spacetime picture.

What about the possibility to unify matter and mind? Will we succeed? And if so, will the successful model turn out to be more like a tower, or a bridge, or a line in the sand? These are the questions we will investigate in the next chapter.

watching the mind

To further prepare for discussing possible unifications of matter and mind, let us continue to explore the mind a bit more. After all, our culture puts far more emphasis on teaching science and hence exploring matter, than on teaching us to observe and explore our own mind. Therefore, we have some catching up to do.

Today's challenge is to watch the antics of our mind. Usually, we are pretty much at the mercy of our thoughts and emotions. We identify with them, consider them ours, and we tend to defend them, when others have different thoughts, or when others hurt or threaten our feelings. But how about suspending that identification for awhile to whatever extent we are able to, to see how far we can go? Can we learn to watch our mental phenomena, without judgment, in the spirit of Husserl's epoché, that we encountered in Chapter 9?

Well, let's try. And it is here that the world's great traditions can offer us help. One of my favorite examples is provided by the Sufi poet Rumi, whose poem "Guest House" can serve as a guide toward exploring our mind. Below is the text in translation by Coleman Barks. I heard him recite his translation in Atlanta twenty years ago while I was visiting David Finkelstein, who was the first to show the physical meaning of the event horizon of a black hole. He was one of the most visionary physicists I ever met.

David and I took a break from discussing his new book that had just come out, in which he presented the most revolutionary non-classical view of quantum mechanics that I have ever seen. We never finished the article we wanted to write on that topic, but I am glad I heard Coleman's reading of Rumi's poetry. Here is his "Guest House" rendition:

> This being human is a guest house.
> Every morning a new arrival.
> A joy, a depression, a meanness,
> Some momentary awareness comes
> as an unexpected visitor.
> Welcome and attend them all!
> Even if they're a crowd of sorrows,
> who violently sweep your house
> empty of its furniture, still,
> treat each guest honorably.
> He may be clearing you out
> for some new delight.

> The dark thought, the shame, the malice,
> meet them at the door laughing,
> and invite them in.
> Be grateful for whoever comes,
> because each has been sent
> as a guide from beyond.

Here the idea is, translated to a modern setting, that you play the role of a bartender. You are standing behind the bar, welcoming, watching, and entertaining all that pops up in your mind, metaphorically all that enters the door of your bar. You never know who may show up but welcome them all.

You may greet a moment of joy by saying "good to see you again, you stepped out for a while, but I'm glad you came back so quickly!" Then a moment later, a strong sense of jealousy may well up, for whatever reason, and you may greet that visitor too by saying "good to see you, it has been a few days, welcome back!" and similarly for any mood or emotion that may appear.

You can explore being a bartender for whatever appears in your mind, in any setting. You could set aside five or ten minutes, sitting in a relaxed position by yourself. Or you can do this while waiting for the bus or train, or even just waiting for a traffic light. Once you watch your own mind, you generally don't have to wait long for the first visitors to enter your bar.

* * *

Chapter 17. Toward a Unification of Subject and Object

Back in chapter 7, I have argued that a full unification of our best theories of matter and mind will have to wait until we have learned to be "fully empirical", as I called it. In physics, during the 18th and 19th century, classical mechanics formed the bedrock for all other theories, but it was just "one-third empirical", studying only the object pole of experience. In the 20th century, quantum mechanics showed us how to deal with objects and interactions, called quanta and measurements, in a unified way, involving notions like entanglement and correlations, making it "two-thirds empirical".

The most logical, and most conservative, extrapolation of this progress would suggest that in 21st century physics, theories will be developed that unify all three aspects of experience, subject, object, and their interactions, making it "fully empirical" in my terminology. The question then arises of how to get started. I can see two natural inroads that we can explore, in order to make headway towards such a unification. And for each inroad, two ways to explore them.

two inroads

The first inroad would be the most straightforward. We can try to make progress toward a theory of subjects by continuing the historical path in which physics went from classical to quantum mechanics. While refining current theories, we can be on the look-out for signs that might indicate further extensions of quantum mechanics, in ways that might naturally call for a fundamental role for subjects.

These would not need to be human subjects; they could be machines, forms of artificial intelligence perhaps, that could play a subject role. Looking for new roles of subjects to fall out of new physics theories would be like building a

bridge by starting at one end and curving up and down past the middle to touch down at the other shore.

The second inroad would follow a different strategy. We can try to make progress toward a theory of subjects by starting from scratch. This would be like building a bridge by first seeing how far you can get from one side, and then starting another building project at the other shore, with the intention to let both sides meet somewhere in the middle.

the first inroad: playing Bohr

Our first choice, extending the bridge till it reaches the other shore, would not confront the question of subjects head-on. Rather, the best strategy would be to not focus on the role of the subject in any specific way. After all, the development of quantum mechanics was not driven by a desire to uncover fundamental uncertainty or spontaneity; those were completely unexpected byproducts.

When Bohr made the first step toward a quantum theory by postulating his still semi-classical Bohr model, the notion of complementarity was still a dozen years away. Even so, it would be wise to be prepared, at least, to recognize signs of new roles for subjects, to speed up the process of interpretation of a new theory. We could call this inroad, extending quantum mechanics while keeping an eye open for the emergence of new views of subjects, as "playing Bohr".

In the case of quantum mechanics, it took half a century, from Bohr to Bell, to discover just how much objects and interactions were entangled. Niels Bohr, Albert Einstein and others had spent many years in the twenties and thirties to figure out what the mysterious quantum correlations meant, and how they could be quantified. But it took a few more decades until John Bell made significant further progress in proving what is called Bell's theorem, published in an obscure place in the sixties, to become widely known only in the seventies.

It was Bell's theorem that showed in a crystal clear way how weird some quantum mechanical effects, such as the 'spooky action at a distance' that seems to accompany quantum mechanical entanglement of particles, really are. He proved that no underlying theory of 'hidden' local variables could reproduce quantum mechanics, at least not without introducing even weirder and seemingly unnatural modifications. In other words, *not only do we not know* of any theory that can explain quantum mechanics through a hidden classical theory under the hood, so to speak, but what is more, since Bell we know that in principle *there does not even exist* such a theory which could give the same results as quantum mechanics (again, barring rather artificial extensions of quantum theory).

the second inroad: playing Galileo

Our second way to make progress is to start anew, and retrace the steps that Galileo took, but this time starting at the subject pole of experience. Galileo studied motion of objects in very simple settings, rolling balls down inclined planes, for example, while recording relationships between time elapsed and distance traveled. These experimental baby steps were essential starting points that within a century would lead to full-blown classical mechanics.

This suggests a name for the second kind of inroad: let's call it "playing Galileo". Like the first inroad, modeled after what happened a century ago, the second one could also be a direct and rather conservative extrapolation of what happened four centuries ago, and with a little luck by the end of this century we might have a full-blown theory of subjects on a par with the theory of objects that only reached self-consistent form in the hands of Newton.

Where quantum mechanics started to build a bridge, anchored in the object pole of experience but bending over already toward the subject pole through its thorough investigation of interactions, the first inroad just keeps building that bridge out further, till we reach the other shore of the subject pole. We will discuss this approach in the next chapter, Playing Bohr. In comparison, following in the footsteps of Galileo may be simpler, starting at the subject pole from scratch. We will explore the second inroad in the chapter following the next one, Playing Galileo.

two ways of exploration

Not only do we have a choice of two inroads, but for each inroad we have an additional choice of two ways to conduct our exploration. These two are quite different in character. The first could be called 'bold and blind', the second one 'modest and meandering'.

To reach a new destination from where we currently find ourselves, we can climb a hill nearby to survey the obvious obstacles in our path. There may be huge boulders that should be cleared out of the way. Or swamps that need to be drained. Jungles perhaps that we need to slash a path through. We may not yet see exactly how to connect the dots between here and our ultimate there, but being bold, we can start to clear the land. Meanwhile we hope for the best, while still being blind as to how to build a complete road, or even whether the landscape allows that to be done. We simply focus on the biggest obstacles first, leaving the rest to worry about later.

The alternative approach is to find an existing road, nearby, that has been only partly completed. We can be modest, and pick up where other builders have left off. While trying to extend the existing road beyond its current endpoint, we can then use a path of least resistance. Avoiding obstacles that are in the way, we are likely to meander quite a bit, but with some good luck we may eventually reach our goal.

the first way: bold and blind

The first way of exploring confronts the underlying hidden difficulties head on. It acts as a catalyst. It does not try to give traffic an immediate way to proceed, but instead it removes obstacles that are likely to prevent premature attempts at road building. An example of an important catalyst was Mach's contribution to prepare Einstein's thinking in developing general relativity.

Mach's principle, as Einstein called it, suggests a version of relativity of motion. When we put water in a bucket, and spin the bucket, the water near the edge of the bucket will raise a bit because of centrifugal forces. Now what would happen, asked Mach, if we kept the bucket still but the Universe spun around the bucket? Newton's equations of motion imply that nothing would happen to the water, but Mach's suggestion was that in that case, too, the water might raise at the edge of the bucket, to preserve a symmetry between the two situations.

It turns out that Mach's guess was not quite what general relativity would later predict, but it helped Einstein think in the right direction by suggesting fresh ways to think about the relativity of forces and motion.

the second way: modest and meandering

The second way of exploring is to take a given road, follow it to the end that it has reached so far and continue building it further. This way requires ingenuity, since it is likely that there was a good reason that the previous builders gave up at the point where they stopped extending the existing road. But it doesn't require the boldness of a creative leap in the dark to spot obstacles that can be moved out of the way, as Mach attempted to do.

The drawback of the second way is that even if we are successful in extending the road, we may find out that it doesn't lead us in a direction that we intended. That still

may be okay, since often unexpected directions turn out to be more interesting than what we originally had in mind. Exactly because the new direction may be beyond our earlier imagination, it may open new vistas. But it also may be less efficient than the bold and blind approach, if it leads to too much meandering along the way.

It is interesting to ponder what would have happened, had Einstein not been around in the beginning of the twentieth century. Almost certainly, someone else would have invented special relativity soon after 1905. After all, both Lorentz and Poincare came within a hair's breadth of stumbling upon special relativity. But it seems likely that the discovery by Einstein in 1915 of general relativity, connecting gravitation with curvature of spacetime, would not have happened for several decades without Einstein.

It surely would have happened in the second half of the twentieth century, when quantum field theories were developed. The first kind was quantum electrodynamics, an example of a gauge theory, but one with a very simple form of gauge field. Soon after that, more complex gauge theories were developed with so-called non-abelian gauge fields. By this time, gravity would have been recognized as the gauge field mediated by gravitons, particles similar to photons but with spin 2 rather than spin 1. The upshot is that without Einstein's bold vision of the equivalence principle, inspired by Mach, a more modest and meandering road would have led to general relativity half a century later.

watching the world

At the end of the previous chapter, we saw how Rumi invites us to watch our mind, as if we were a bartender, or in his original description, someone running a guest house. Today let us continue our exploration by an approach from the other side of the mind-world circle. Let us watch the world, with the Chinese Zen master Rinzai (d. 866), in a commentary provided by a contemporary Japanese Zen master, Shodo Harada (b. 1940).

In one of his talks, Harada starts out by quoting a line from Rinzai's sayings:

> In this five-foot lump of red flesh there is a true
> person of no rank always coming in and going out;
> if you have not seen it yet, see it now!

and then adds his own comments, about this mysterious person of no rank, that sense of a non-conceptual self beyond our conventional story-telling self. Of his comments I found the following two paragraphs most helpful:

> It is always coming and going
> in and out of our body.
> When it goes out, if we see a flower,
> we become a flower;
> when we hear a beautiful bird's song,
> we become a singing bird.
> When we go within, we are hungry,
> sleepy, hot, and cold.
> There is a true master like that
> within each of us.
> We see a river and we are flowing
> without pause.
> We see the sky full of stars and
> we become it all.
> We dive into the suffering of all people,
> into society's miseries.
> Within this is a true person of no rank.

Without adding further commentary to Harada's commentary to Rinzai's commentary on his experience of reality, I am happy to leave it to the reader to explore the taste of this kind of transcendence of the subject/object polarization, while moving to and fro, between watching the mind and watching the world, or better, between being the mind and being the world.

* * *

Chapter 18. Playing Bohr

Here we will follow the first inroad, mentioned in the previous chapter. This implies extending the progress in science, in particular in physics, where two centuries of object fascination was followed by one century of object-interaction fascination. The idea is to be on the lookout for signs that the fascination will be enlarged again naturally to include all three aspects of human experience: object, interaction, and subject.

We called this 'playing Bohr' to indicate that we are following in his footsteps. Bohr had no intention, in fact he had no concept even, of becoming a pioneer in a project of unification of objects and their interactions. When he put forward his semi-classical, semi-quantum Bohr model back in 1913, he was just engaged in doing physics research, trying to come up with better descriptions of the structure and properties of atoms.

It was more than a decade later that he got involved in the deep philosophical question of how to deal with the seemingly contradictory pictures that arose from the new physics of quantum theory. Quanta could be described as both particles and waves, and there was no classical way of admitting both sets of properties in one and the same object. In due time this would lead to quantum concepts like complementarity, and later entanglement.

lucky us, at the start of the third act

We who are alive today, are lucky in having arrived on the scene of progress in science at the beginning of what I see as the third act in the development of empirical science. In fact, we are lucky in two different ways. After the first act completed by Newton, science had become one-third empirical. After the second act, largely completed through the trajectory from Bohr to Bell, science has now become two-thirds empirical. My prediction is that this

means that we are the ones to witness the process of completion of this centuries long progress, in seeing science enter its third and last act toward becoming fully empirical.

So we are lucky to have front row seats in watching the beginning of the end stage of this process of maturation of science, and with the right training and background we may even take part in the game. And if we do, we are also lucky in having it easier than Bohr and others a century ago. For the pioneers of quantum mechanics, it was traumatic to be forced to shift toward a new and totally unexpected act in the drama of the development of modern physics. In comparison, having seen physics shifting acts once, it is now much easier for us to recognize and welcome another shift.

It is hard to overestimate the force of conviction, the virtual certainty in Bohr's younger days, of there being one and only one act in the drama! Aristotle's theories had reigned supreme for about two thousand years. During the seventeenth century, his ideas were dethroned, and from there on Newton's classical mechanics reigned supreme. For all intents and purposes, experimentally and theoretically, his theories had all the signs of being firmly established, as the be-all and end-all of the ultimate description of the nature of reality.

trauma for poets during the first act

For a couple decades, the mechanistic picture of nature, where each object could be described fully and objectively, independent of who made an observation or measurement when and in which way, was the only game in town. For a long time after Newton, this picture seemed to have succeeded in dispelling once and for all any form of mystical holistic thinking, in which objects were intrinsically woven together with the interactions they were involved in with their surroundings.

After Newton, that old picture seemed something of the past, to be discarded like superstition and mythology. It had become quaint, an understandable aberration given the limitations of past knowledge but no longer of any interest, except to historians and some poets and writers who resisted the rationality of the eighteenth century enlightenment.

Prominent examples of the latter were William Blake and Johann Wolfgang von Goethe. Both of them vehemently opposed the Newtonian view of the world. Goethe even went so far as to try to produce a fully alternative way of doing physics but without any clear connection to the physics of his day.

trauma for physicists at the end of the first act

Fortunately, physicists did not abandon their theories just because they did not look or feel pretty. Science is not a fashion, and there are no opinion polls as to whether or not people like the outcome of experiments. Scientists follow the increasingly accurate succession of theoretical and experimental improvements wherever the evidence leads to.

And so it was that mechanistic rationality continued to dominate scientific thinking. It seemed that for the next hundred years after Blake and Goethe, the romantic movements of the nineteenth century could be appreciated for their poetic value, perhaps, but could not be taken seriously in the evidence-driven empirical way of science.

Until the evidence pointed into a different direction.

When it became clear soon after the birth of quantum mechanics that individual experiments could not be reproduced except in a statistically average way, and that nature therefore is not deterministic as the mechanical world model would have it, the result was traumatic. Who could have thought that two scientists could do the exact same lab experiment but get two very different outcomes? That flew in the face of all that Newton's theories had implied as being the rock bottom of material reality.

continuity across acts

Surely all was not lost. For an ensemble of identical measurements, the average behavior in many cases was close to the classical result. If that had not been the case, classical mechanics could never have developed as a good approximation to reality. But there were instances where even the average behavior could be very different from what had been expected.

For example, phenomena like tunneling through barriers, predicted by quantum mechanics, and amply verified by experiments, appeared on the scene like strange forms of magic, defying any classical intuition or expectation. But soon it turned out that without quantum mechanics, you could not explain simple every-day effects, like conduction of electricity through a wire and a host of other things.

Similarly, a future theory of subject-interaction-object integration must preserve what we know and to the degree that we have tested it as confirming closely to our current scientific theories. At the same time, we can expect it to add amazing new features that no one currently foresees.

from bold and blind to modest and meandering

In the previous chapter I made the distinction between two ways of exploration. So far, in the above, I have taken the 'bold and blind' way, in trying to act as a catalyst,

pointing out boldly what I think will happen within the near to mid term future, without making any suggestion as to how it may happen and what form it may take.

My hope is that some young scientists will keep in mind the idea that the role of the subject may actually fall within the realm of future physics theories, and then recognize that possibility when sufficient progress is made. That is the role of a catalyst to speed up a process that otherwise might have taken much longer.

But I don't want to stop there. I had mentioned as an alternative the 'modest and meandering' way. In that more modest spirit, I am happy to make some suggestions as to how current physics may continue meandering through terra incognita but in ways that could optimize the chance to find a new role for subjects, within empirical studies of nature. And as you may have guessed by now, I will take the most conservative approach.

new forms of mathematics

Let us again try to extrapolate from the past. We can easily see that the most fundamental breakthroughs in physics as a rule have been accompanied by the introduction of fundamentally new mathematics. Newton had to invent calculus. Einstein had to learn differential geometry, which had not been used in dynamics before. Quantum mechanics also introduced newly discovered forms of mathematics into physics, such as the use of Hilbert spaces and non-commuting variables. This all makes it very likely that a new science of the subject will entail new forms of mathematics as well.

Given the tremendous proliferation of new areas of mathematics in the century since the invention of quantum mechanics, it is quite possible that there are already one or more types of mathematics that are suitable for unifying object, interaction, and subject. One intriguing possibility would be the use of category theory.

Where set theory uses points and circles to depict elements and sets, category theory adds arrows as fundamental objects. These arrows have orientation: each arrow points in a particular direction: head and tail are not interchangeable. This may suggest that category theory could form a natural language to describe the asymmetric relationship between subject and object.

In addition, when I started learning category theory, I was struck by the pictures of initial and terminal objects, pointing into or out of a category, respectively. They reminded me of the motor part and the sensory part of our nervous system, with which we choose objects to manipulate and classify the world into objects, respectively. This is not the place to go into further detail, but it is a topic of ongoing discussions for me with several colleagues of mine in various institutes.

adventures in mathematics

Category theory is only one possible place to look; there are many alternatives. In general, it might be fun to bring together mathematicians, theoretical physicists, and other interested scientists, logicians, computer scientists and philosophers who have a working knowledge of the basics of quantum mechanics and of the lay of the land in mathematics. Even if only for a weekend workshop, they could come together in small groups, small enough to let everybody speak up without having to wait too long for their turn. Groups of seven or so participants might be ideal.

In such a setting, one or more mathematicians could introduce their favorite type of not-so-well-known mathematics, giving a feel for the kind of theories that they are and speculating on what they might be good for in exploring possible applications to describing subjects. The others could then comment, and the whole group could brainstorm as to what new applications might be developed.

The main focus of such discussions would be the question of what is left out when we consider a subject as nothing more than a complex intelligent object. Whether a person or an artificially intelligent machine, science could try to describe that subject in a very detailed way, based on the causal interactions of all its constituents. But obviously, that is not how we see ourselves, and perhaps not how we should see artificial intelligence either.

With subjects, as autonomous agents that have their aims and needs, turning the arrow in time around can be more efficient in characterizing them. For a human, animal or robot, an ear is there to hear, which is a six-word simple sentence. To characterize the causal mechanism of how an ear works, in full glory, may well take many volumes of detailed descriptions.

In general, when biologists describe an organism, they list its features by the functions that they perform, rather than by making a list of the parts it is composed off with an even larger list of processes that take place between those parts. In that sense, biological descriptions and explanations often run backwards in time compared to explanations in physics or chemistry. An animal perks up its ear in order to hear better: the desired future action of hearing better 'explains' the current action of perking up its ears – even though ultimately there must also be a possible description in terms of molecular motions, vastly more complex, with an 'emergent' result of allowing better hearing.

So how can time reversal give us a clue as to how to think in fresh ways of subjects, or agents in general, that are more than the sum of their parts? This is a topic of interest in current research, where terms like 'downward causation' are toyed with to see where such ways of looking 'through the other side of the telescope' can help.

Even if nothing else would come out of such workshops, everyone would still learn something new: new types of mathematics, or new aspects of the expertise that other participants would bring to the table. All this could become even more promising if some of the participants were to engage not only in 'playing Bohr', but also in 'playing Galileo', the topic of the next chapter.

watching your hooks

In the previous two chapters, some suggestions were presented to watch mind and world, as forms of explorations of their interactions. Here is another suggestion, in the form of a way to watch how the mind gets hooked into the world, and thereby can lose sight of much of its innate freedom. Or as physicists would say: how a loss of degrees of freedom can lead to an impoverished playing ground of lower dimensionality.

The core idea is presented in one of my favorite quotes of Nisargadatta, a Hindu merchant running a small shop in Mumbai where he sold hand-rolled leaf cigarettes. I found it in a book of interviews with him, with the title "I am That", published in 1973:

> It is disinterestedness that liberates. Don't hold on, that is all. The world is made of rings. The hooks are all yours. Make straight your hooks and nothing can hold you. Give up your addictions and the freedom of the universe is yours. Be effortless.

I find this image nicely complementary to Rumi's image of being a bartender. A wise bartender does not get snarled in the arguments of the customers. He or she follows their conversations with interest and empathy but without getting swept up and away by the emotional aspects of the discussions.

This passage reminds me also of Man Ray, an American artist living in Paris in the early to middle parts of the previous century, whose tombstone in the Montparnasse Cemetery bears the inscription "unconcerned, but not indifferent". Please enjoy reflecting on and playing with the suggestions given by Rumi, Nisargadatta, and Ray with their different backgrounds as Persian Sufi poet and scholar, Indian Hindu cigarette merchant, and American avant-garde artist.

* * *

Chapter 19. Playing Galileo

In the last chapter, we started to explore how the further progress of physics may stumble upon a special role for the subject pole of experience, quite likely with an extended form of mathematics to express that role. We called that approach 'playing Bohr', to indicate how the attempt to extend the state of the art in science may force us to think in totally new ways about the meaning of empiricism.

In this chapter, we will explore the alternative approach, 'playing Galileo', in which we explicitly look for new ways to describe subjects. Just like Galileo did a series of experiments with simple motions of simple objects, to bootstrap classical mechanics from the ground up, we can try to do something similar for the most basic aspects of what it means to be a subject.

robotics

One place to start is in robotics. After I had attended a few phenomenology conferences in the 1990s, I was surprised that I heard a lot of talk about Husserl's transcendental subject, but I didn't hear anyone talking about robots. I then responded to the request by John Brockman, the world's leading scientific literary agent, to answer the question "What is the most important invention in the past two thousand years?", for his on-line World Question Center, for New Year's Day 2000, as follows:

> “Building autonomous tools is my candidate for the most important invention.
>
> “Artificial complex adaptive systems, from robots to any type of autonomous agent, will change our world view in a qualitative way, comparable to the change brought by the use of thing-like tools.

> "Tinkering with tools has shaped our view of the world and of ourselves. For example, the invention of the pump enabled us to understand the mechanical role of the heart. Science was born when laboratory apparatus was used to select among mathematical theories of the physical world which one correspond most closely to reality. But all those tools have been lifeless and soulless things, and it is no wonder that our world view has tended to objectify everything. Grasping the proper role of the subject pole of experience, through the invention of subject-like tools, may provide the key to a far wider world view.
>
> "With the invention of perspective, in the late Middle Ages, we shifted our collective Western experience one-sidedly into the object pole, leaving the subject pole out of the picture. We started looking at the world from behind a window, and a couple centuries later, in science, we attempted to take a God's eye view of the world. By now, we are coming around full-circle, with our science and technology providing us the means of exploration of the role of the subject.
>
> "We have only set the first steps towards building artificial subjects. Just as our current artificial objects are vastly more complex than the first wheel or bow and arrow, our artificial subjects will grow more complex, powerful, and interesting over the centuries. But already we can see a glimmer of what lies ahead: our first attempts to build autonomous agents have taught us new concepts. As a result, we are now beginning to explore self-organizing ecological, economic, or social systems; areas of study where thing-like metaphors hopelessly fail.

embodied robots

In the two decades since I wrote the above, the explosion of AI applications has given us plenty of examples of more

subject-like behavior of machines, whether physically resembling humans, coming in different shapes, or distributed over the internet. This means that we have far more subject material, pardon the pun, to begin playing Galileo.

In 2002, a fascinating popular science book came out, "Flesh and Machines: How Robots Will Change Us", by Rodney Brooks, the roboticist whom I most admire for his creativity, ever since he totally revolutionized the field of robotics in the early 1980s. His intellectual leap was to switch from a view of robots as objects that are capable of very complex computations to guide their interactions with the world, to robots as embodied entities that respond to their world in rather simple ways. In my terms, he was the first to connect the subject pole of robotic experience with its interactions and with objects that were interacted with.

In short, before Rodney's work, people had tried to build robots as lifeless machines with a little mathematician buried inside, doing fancy calculations in terms of mapping the world and plotting trajectories for the robot through the world, leading the robots to lumber along and run into walls. Rodney instead took the example of cockroaches, who know nothing about math, but at least don't lumber along and don't run into walls. His robots, modeled on insects, ran circles around all of the older-type robots, performing well in real life environments, far better than any robot had before.

updating Husserl

A few years after reading Husserl in the early 1990s, I heard about Rodney's work, and during one of my visits to MIT, I got a chance to meet him. I was introduced to Rodney by Gerald Sussman, another 'philosophical engineer' as he called himself, with the same spirit of deep inquiry as Rodney. Gerry and I had been working on problems in computational astrophysics already for a decade and wrote various pioneering papers on our views

on the future use of AI in astrophysics, some thirty years before such applications became more mainstream.

Around that time I had immersed myself in Husserl's discussions of experience in terms of noesis, noemata, and the phenomenological transcendental subject, published eighty years earlier. I had attended conferences and sought out various philosophers specialized in phenomenology.

However, at that time none of them seemed to have much interest in extending Husserl's views to problems in modern cognitive science. In that context, I was delighted to find new inspiration for extending Husserl's old views of the role of the subject in Rodney's practical embodied approach to robotics.

juice

When I read Rodney's 2002 book, I was intrigued by his suggestion that our understanding of living systems may miss some new concept, which he jokingly called a new "juice", something that living organisms have but non-living things don't. And he didn't think about any mysterious new ingredient to the inventory of the world. With the same intuition I described in the previous chapter, he thought it might be found in the form of a new kind of mathematics.

He wrote: "But where might we look for such a mathematics? Ah, if only I knew!", then offered some general directions involving physics and computation, and added, "But this is just one obvious place to look. The real trick will be to find the nonobvious, for if the juice hypothesis is true, that must be where it is hiding."

He concluded his brief discussion by speculating about the possibility of there being different juices for different aspects of biology, mentioning perception, evolution, cognition, consciousness or learning, and concluded:

> “Or perhaps there will be just one mathematical notion, one juice, that will unify all these fields,

> revolutionize many aspects of research involving living systems, and enable rapid progress in AI and Alife.

His notion of juice comes close to my notion of a special role for the subject, as opposed to objects, in experience.

a fun meeting at the Santa Fe Institute

In the previous chapter, I mentioned the possibility that we will find new forms of mathematics that may be promising for unified descriptions of subjects, objects and their interactions. If we stumble upon such a formalism, akin to Rodney Brooks' juice, we would be extraordinarily lucky. And it may be category theory, which I mentioned as one candidate and which Rodney also mentioned in a footnote in his book, referring to Robert Rosen, who advocated the use of category theory in mathematical biology.

I reread that passage in Rodney's book while writing this book, having just talked with Rodney in Tokyo at the yearly international Artificial Life conference there. Fun memories came up for me from another meeting, a quarter century earlier: a workshop at the Santa Fe Institute in the spring of 1994 on the Limits to Scientific Knowledge. It was there that I first met both Roger Shepard and Bob Rosen, who exposed me to category theory for the first time.

Ralph Gomory, then the president of the Sloan Foundation, had called the meeting. He told us that he had spent many years giving out money to *increase* scientific knowledge. But from time to time he had asked himself whether it would be possible to have knowledge about the *limits* to scientific knowledge. Could we scientifically explore the limits to the possible increase of scientific knowledge?

crazy enough?

I was invited to the workshop by Joe Traub, a leading computer scientist from Columbia University, whom I had

met several years earlier when he was the director of one of the NSF supercomputer centers in the US, located in Princeton. As one of the main users of that center, for my large-scale simulations of stellar dynamics in astrophysics, I had gotten to know him, and we regularly found ourselves engaged in dialogues about various philosophical aspects of computational science.

When Joe asked me to come to the Santa Fe workshop, my first reaction was to decline. I told him that I thought that the workshop would be pretty crazy, in going well beyond the mainstream questions in science, but probably not crazy enough to ask the most important questions, way beyond what the mainstream was concerned about.

After Joe twisted my arm again a little later, I decided to give it a try, and I did enjoy the meeting, as well as the Santa Fe Institute, where I visited for the first time. But even so, nothing really new came out of the meeting as I had feared, and at the end of the week, everyone was eager to go back to their labs to continue their mainstream work.

all he got was an astronomer and a psychologist

On the last morning of the meeting, Ralph Gomory came with a surprise announcement: he had decided that the Sloan Foundation would ask all the participants to apply for a grant to further study the limits to scientific knowledge. To make it easy and attractive to do so, a short two-page description would suffice.

I'm pretty sure he had hoped to see applications for grants to study in more detail areas such as quantum uncertainty, Gödel undecidability, the Turing halting problem, or fancy theoretical topics like that. But to his surprise, only two people stepped forward, namely Roger Shepard and me.

Roger, a leading cognitive psychologist from Stanford University was visiting the Santa Fe Institute on sabbatical,

and attended the workshop more or less as an interloper who happened to be around. He and I hit it right off from day one and had already decided to start working together. In my opinion, he was the only one there 'crazy enough' to really look for new ways of doing science without being 'too crazy' as some of the others seemed to be in a group with most participants simply 'not crazy enough'.

It was clear that Ralph was a bit disappointed. I could almost see him wearing a T-shirt saying, "I organized a workshop at SFI on top-level problems in theoretical physics, computer science, and mathematics, and all I got was an astronomer and a psychologist." But given his promise, he had no choice but to fund us, and for two years we invited 'crazy enough' scientists for small informal workshops at Stanford for a weekend on a monthly basis, five or so scientists and scholars at a time. Those meetings turned out to be some of the most interesting ones in my life.

betting my money

Returning to my suggestion in the previous chapter to be on the lookout for new mathematics, and paralleling Rodney Brooks opinions in his book, yes, we may be lucky and stumble upon a promising new form of math. But if I were to bet my money, I would do so on an approach that involves starting from the phenomena, rather than from ungrounded guesses about their mathematical descriptions.

Even if we were to guess correctly as to a new form of mathematics, there is no guarantee that we would be able to decipher its usefulness. After all, string theory, enticing as it is for sure, after a few decades of intense scrutiny, has not yet found a concrete application in terms of an extension of particle physics theory. My guess is that in due time it will, since there are just too many mathematical breakthroughs that have been found using string theory compared to what would be expected from a random new physics approach, so most likely something profound is lurking somewhere in there.

As a bit of personal background, I was lucky enough to have been exposed to early versions of string theory and supergravity during my graduate student days in the theoretical physics department at Utrecht University in Holland. I vividly remember the excitement in the mid 1970s when Peter van Nieuwenhuizen, like me a student of Tini Veltman, gave his first talk about supergravity, which he had just discovered, together with Dan Freedman and Sergio Ferrara. So it has been fairly easy for me to follow some of the main developments in string theory, including the inclusion of supergravity soon after the first superstring revolution, and to appreciate the beauty of string theory from a mathematical viewpoint.

robotics, phenomenology and contemplation

I alluded above to the problem that guessing the form of a promising mathematical theory does not mean that its applications will soon be apparent. I mentioned string theory, which more than half a century old and has been intensively studied by many of the brightest theoretical physicists for a third of a century but with no clear signs yet of arriving at a deeper unified theory of nature.

Therefore, in addition to playing Bohr, by pushing further with extensions of theoretical physics theories, I suggest as a parallel alternative to enlist other players besides physicists. My prime candidates are roboticists, phenomenologists and contemplatives. In chapter 8, I have introduced Husserl's epoché as one approach. And in the two chapters following that chapter, I outlined connections between Husserl's phenomenology and contemplation.

with a little help from my friends

Following the publication of this book, I am looking forward to organizing and participating in workshops with others who are 'crazy enough' to look for fundamentally new ways to study the nature of subjects, or, using Rodney

Brooks' terminology, to look for the juice in what makes life alive.

In addition, I would like to co-author several more books on the nature of empiricism and the role of subjects, interactions and objects in experience with specialists in various areas. Although it has taken me a few decades to formulate my thoughts in the current book, I feel the time now has come to work things out in far more detail with a little help from my friends.

In the spirit of that same old Beatles song, my intention at the start of this book was to ask "Lend me your ears and I'll sing you a song". Like Ringo Starr, I have tried not to sing out of key, and I hope others will help me to stay in tune in sharing subsequent endeavors.

The next chapter, the last one of Part IV, will be more speculative, while looking ahead at scientific developments well beyond the current century. After that, in Part V we will come back to the present, to see what can be done already right now, before a future unification of subject, interaction, and object, and well before an even later scientific study of the non-duality of subject and object.

watching yourself

Continuing our series of suggestions, to watch the mind, to watch the world, and to watch our hooks, here is another suggestion as to what to watch. We all have the tendency when things aren't going too well to withdraw onto ourselves. What happens when we don't give in to that tendency to centralize onto ourselves?

It will be an easy exploration. Many times a day, our mood ebbs and flows. For a while, we may feel more open and expansive, and then, with or without any obvious trigger, we may narrow down and withdraw a bit. Somewhat later, we feel like opening up again more to the world. And

before we know it, something happens that makes us draw up the bridge once more over our protective moat.

Because this happens all the time, it is not hard to notice it once we set our mind to it. And in principle, it is not hard to avoid giving in to this tendency to centralize. In practice, well, all good things need practice, so why not try this for a while? It may give you a pretty direct glimpse of the role that the subject, our sense of self, plays in your life.

Here is a text that I have found useful, as a quote from a Tibetan Atiyoga text, which has been variously ascribed to different sources (it seems to have been cited by Dilgo Khyentse, Chogyam Trungpa, and possibly others). Wherever it may have come from, it is a great instruction for exploring our life and mind as a lab:

> "Since all things are naked, clear
> and free from obscurations, there
> is nothing to attain or realize.
>
> "The everyday practice is simply to
> develop a complete acceptance and
> openness to all situations and emotions.
>
> "And to all people -- experiencing
> everything totally without reservations
> and blockages, so that one never
> withdraws or centralizes onto oneself.

* * *

Chapter 20. Playing Nagarjuna

In classical mechanics, reality is embodied through objects, things that have properties, such as shapes or states of motion. These things could be individual particles, or fluids that exhibit waves, but either way they are objects to be studied and described by humans, whose bodies themselves are complex ensembles of objects.

In quantum mechanics, the properties of objects are not just 'sitting there' as something to inspect. To determine the property of an object, you have to use a procedure, technically called an operator in a mathematical space, to interrogate the object. This then will yield a result but with an intrinsic and well defined uncertainty that cannot be made arbitrarily small. This framework implies that object and interaction, together, determine the value of whatever is measured. And at the end it is not possible to determinate which part of the final outcome is caused by object and which part by interaction: they are given together.

It is my expectation that within a century or so, a new theory, further refined beyond quantum theory, will present a unified description of subject, interaction and object, including the way in which each of the three give a unique contribution to the experience resulting from subject interacting with object. Once such a theory is developed, tested, and agreed upon, it will become clear in exactly what way the subject is more than how we now view it: as just a very complicated object that can measure properties that are entangled with other objects. Or in Rodney Brooks' terms, what the 'juice' will be that distinguishes a subject from an object.

But I don't expect the history of fundamental physics to stop there either. My best guess would be that in the centuries following the derivation of such a “fully empirical” physics theory, involving all three components of experience, an even deeper understanding will unfold.

borrowing databases

In Chapter 6, I mentioned how Greek astronomy a couple thousand years ago got started by borrowing the astrological database from the Babylonians, and how European chemistry a couple hundred years ago got started by borrowing the database from their alchemy predecessors.

I then played my usual conservative role in making the simplest and most straightforward extrapolation, in guessing that a better understanding of cognition, and specifically of the role of the subject in experience, could be arrived at by similarly using an older existing database.

In the previous chapter I mentioned how 'playing Galileo' could become a team sport with contributions from various players, including not only physicists and mathematicians but also roboticists, phenomenologists, and contemplatives, each offering their own databases. And among them, the contemplatives possess by far the most detailed, rich, and diverse treasure chest, a collection arrived at through the sustained efforts of some of the best and brightest individuals in a number of different cultures over thousands of years.

I strongly suspect that such databases will provide valuable support for the 'playing Galileo' enterprise. But I also suspect that similar databases may well help to continue the growth of science further, even beyond the Galileo stage.

a critical look at empirical knowledge

What would be the reason to look further, once we have acquired a fully empirical theory of reality, as I have projected as a possibility in previous chapters? Going from 1/3 and 2/3 empirical to the obvious next step of completion, a fully empirical way of dealing with reality, seems pretty straightforward. What more would there be left to do?

A short answer would be that it is my hunch that any understanding that is conceptual in nature falls short of complete knowledge. And if that were indeed true, it would imply that any understanding that can be expressed linguistically, whether in formal or informal languages, would suffer from that limitation.

I use the word hunch because I feel that I am on less solid footing here than I think I have been thus far in the book, in the relatively straightforward extrapolation of current science toward a more complete, fully empirical version. Let me mention a few triggers that for me have contributed to that hunch.

a couple triggers

One trigger is to become aware of the fact that our self identity is made up out of a tightly woven garb of stories. We see ourselves through, and often identify with what we are depicted in, the stories that others and we ourselves tell and think about us. Each story projects a shadow on our collective linguistic wall, and what we think we are is put together through some kind of tomography that we try to apply to the heap of stories accumulating around us. But we are more than the sum of our stories, and unlike in tomography, the stories are always spotty, leaving quite big gaps between them.

Another trigger can come from watching young infants and animals experience themselves and their world, and to see how very direct their experiences are in comparison to our much more conceptually driven and filtered ways of sensing the world. Anyone having a pet knows how intensely they can experience the world, in between long times of napping and lazing around.

Just one night of camping out in the woods, with minimal gear and without using a cell phone or any other form of modern technology, can show vividly how different it is to directly interact with nature compared to how we live much

of our modern lives cooped up in our homes or offices. Just hearing rain drops at night and birds in the morning, with unfamiliar smells wafting through the tent openings, can open our eyes and ears and other senses to a totally different way of life. And even then, most of the time we are still caught up in storytelling thoughts!

a couple more triggers

A third trigger can come from a sustained engagement in some form of mind-body practice, like yoga or tai chi or other kind of martial art; or it could be a type of sitting meditation. It could also be an engagement in sports, such as long distance running. It could even be fishing, where the steady relaxed gaze at the water may instigate a form of contemplation. Or for that matter, it could be smoking a pipe or cigar or cigarette, which like fishing presents an answer to the traditional objection "why do you just stand there, go do something!" In our culture, fishing and smoking are two ways to pretend you're doing something in order to not look suspiciously idle (although the smoking trick is rapidly going out of fashion these days).

Whatever your choice of third trigger may be, it is likely to bring you in touch with non-conceptual experiences, in which the distinction between subject and object weakens and may even drop away, for at least a short time. Taking certain drugs may also provide a similar trigger, but with the obvious dangers of creating addiction at best, and death by overdose at worst. And besides, taking chemicals does not really make non-conceptual experiences part of your own repertoire since they are externally induced.

A fourth trigger can come from meeting someone who has embodied to a smaller or larger extent non-conceptual insight to show clearly enough that we humans have the ability to fall into such ways of knowing. Such a meeting can be a physical meeting with an individual, or it can come through reading a book and falling into the message conveyed in that way; or through watching a movie, or just

hearing someone talking about someone else they met or know about.

a personal mix

Anyone I know with a keen interest in non-conceptual ways of knowing, has his or her personal mix of triggers that may likely have been trip wires, although in practice it may never be fully possible to ascertain what triggered what. In my own case, there are a few that stand out when I was a young teenager, well before I started to experiment with meditation, later on in high school. Let me mention just one.

I guess I was fifteen or so, when one evening I walked back home in the dark in the small country village where our family was living at that time. All of a sudden, I stopped dead in my tracks and just stood there. It had occurred to me, very vividly, that I was not the one talking when I talked.

I realized that my sense of being the creator of the sentences I spoke was false. I saw suddenly how at the start of a sentence, while already uttering the first few words, I had no idea how the rest of the sentence would be spun out or who would do that for me. It always just happened. And because it always just happened, we take it for granted. But that doesn't make it less mysterious.

At the same time, I realized how the same paradox occurs when I am thinking. Formulating thoughts is like speaking to myself, therefore subject to the same mystery. I wondered who or what was thinking my thoughts, and what my role could possibly be in all that. This was well before I had read anything about mysticism or contemplation, East or West, or about meditation or anything like that.

Der Himmel über Berlin

I suspect that many children have experiences like that, during which they wonder about the world and their relationship to it. Almost certainly I, too, had much earlier

moments of wonder and wondering, and I may well have forgotten most of them. But from time to time, reading a novel or watching a stage play or movie, earlier wonder experiences may be revived and revisited.

For the case of what made me freeze in my steps, as a young teenager, I remember having a flashback to that occasion when watching Wim Wenders' wonderful movie "Der Himmel über Berlin", more than thirty years ago when it came out. The English title is "Wings of Desire", a great find, since 'Himmel' in German can equally well mean sky as heaven, and both were meant. In the opening scene angels, dressed as average Germans, moved in the sky above Berlin as inhabitants of Heaven, until one of them got the desire to come down to Earth as a human.

What triggered my flashback were the lines in Peter Handke's poem "Lied Vom Kindsein", written for the movie, especially in English translation:

> “When the child was a child
> It didn’t know it was a child.
> Everything was full of life, and all life was one.

and

> “Why am I me, and why not you?
> Why am I here, and why not there?

Who knows what other memories there are, for any of us, waiting to be triggered?

Buddhism

When talking about a rich database that we can use in our explorations, the vast Buddhist literature comes to mind. And if we want to go beyond concepts in a really radical way, the Madhyamika literature offers many starting points (also spelled Madhyamaka; as usual, there is strong disagreement as to what is the proper spelling).

Since Nagarjuna is considered to be the originator of the Madhyamika movement, we can borrow his name in giving a label for the next step beyond playing Bohr or Galileo. Once we will have some idea of what it could mean to become fully empirical, an attempt to go beyond conceptual experience could well be called 'playing Nagarjuna'.

This is not the place to give an introduction to Madhyamika. I hope to do that elsewhere, in collaboration with one or more specialists, who can keep me honest. Just as a teaser, let me add here that pondering Madhyamika ideas together with contemplative practices has profoundly changed my view of reality, and what the notions of 'timelessness' and 'no-self' may mean. For the last decades, every year I feel I am understanding those notions on deeper and richer levels that are also harder to put into words.

can science grow beyond concepts?

Whether science can ever grow beyond becoming fully empirical is a fascinating question. Alas, it is a question that future generations will be much better equipped to discuss after the subject role has been properly incorporated into science. But we can at least speculate a tiny bit here.

Whenever a friend asks me to explain what it is like to dive deeply into contemplation, at least to the extent that I have personally experienced, the first image that comes to mind is to compare engaging in contemplation with doing mathematics. In both cases, you can read the instructions, but for a while chances are that you cannot make head or tail of the explanations. But then, after rereading and puzzling and staying long enough with the sense of puzzlement, sooner or later a light bulb lights up, and you suddenly begin to see how to connect the dots. And a while later, other light bulbs light up, and then begin to shine more brightly, the deeper you plunge into the real meaning behind the symbols and definitions.

So while the instructions use concepts, and the symbols used are part of a language, in doing math the actual experience of 'getting it' seems to go beyond concepts. Now if that is the case, it is conceivable that a future science-beyond-concepts could still use a form of mathematics to instruct students to 'get it'. And it may well be that a fusion of mathematical ways of thinking and contemplative ways of thinking may be more effective than the traditional practice of reading revered scriptures written by the contemplative masters of the past. After all, students learn physics from textbooks, not by reading Newton's Principia.

And looking back at Greek history, at the roots of current science, it is at least intriguing to see that some of the great philosophers, like Pythagoras and Plato, considered mathematics and contemplation to be absolutely essential elements in the schools that they founded.

watching

In the last four chapters, we have played with watching mind, world, hooks, and tendencies to centralize. Now the time has come to . . . just watch. Watch, and while watching, respond to the whole situation you are watching, expressing yourself completely, in such a way that watching and expressing become one.

Here is a quote from Shunryu Suzuki, a Zen master from Japan who moved to San Francisco, teaching there in the sixties:

> "We don't know what will happen in any moment. So, in each moment, if you fail to express yourself fully you will regret it later. Because you expect some other time -- a future, a time in which you are more real -- you fail to express yourself fully right now. And of course in this way you will be misunderstood by your friends, even by yourself. So you should always express yourself fully.

It reads like a martial arts instruction, and at the same time it is simple, down to Earth, easy to understand. The point here is to not hesitate or deliberate endlessly, weighing conceptual reasoning of one type against reasoning of other types. Timidity and hesitation is what leads us to hold back and wait, postponing our expressing ourselves.

I copied this text in the early eighties when I regularly visited the Berkeley Zen Center. At that time I was briefly teaching in the astronomy department at UC Berkeley before I got my current position at the Institute for Advanced Study in Princeton. That center was a branch of the San Francisco Zen Center, and they had some typed copies lying around of lectures given by Shunryu Suzuki. It has been an inspiration for me ever since. I don't think it got published anywhere.

Reading the text for the first time, I recognized with a shock how we indeed tend to think that we'll be more real in the future. We tend to act on behalf of a future self, ignoring so much of what is going on right here and now, not really watching it, while deprecating our present existence. Continuing to read, I realized with a second shock how that way of life is indeed a recipe for misunderstanding ourselves. I'm offering this, across time, from the sixties to the eighties to current readers in this century to play with in their own lives.

* * *

Part V. What Can Be Done Now

Chapter 21. Playing Descartes

In this fifth and last Part, the time has come to look at what we can do, here and now, with the ideas that have been presented so far in this book.

I would already be very happy if my writing has kindled some interest in the possibility of connecting science and contemplation, which I consider two of the greatest achievements of human beings. Science and contemplation are the topics of Part I and II, respectively.

And I would be even happier if my musings about possible integration, or even unification of these two great achievements were to inspire younger generations to start working in those directions. Integration and unification of science and contemplation are the topics of Part III and IV, respectively.

But I would be most happy if a growing appreciation for the combined value of science and contemplation were to lead to practical results, already in the world of today. Urgent problems like the ongoing environmental degradation clearly need all the ingenuity we can muster, using head and heart -- that is, science and contemplation, broadly conceived, including social science, philosophy, as well as art, design, technology and other fields of human creativity and expertise.

a community endeavor

I foresee the possibility of a community endeavor, to explore the roles of science and contemplation in many fields of knowledge, and more broadly, in many ways of knowing. It could take many possible shapes. It could start

as a volunteer movement, and it could grow into a research center, but if so, not an isolated think tank. Rather, it should include vibrant interactions with its environment, through both outreach and 'inreach' as a two-way street. It could even grow into a kind of university, a center of learning where every discipline is represented, within a shared atmosphere of respect for both science and contemplation.

In Chapter 24, I will summarize a few of my experimental attempts at setting up such communities, going by names like the Kira Institute, Ways of Knowing, Play as Being, and YHouse, some of which are still running. As yet, none of these endeavors have grown into self-sustaining institutions with full-time staff and guaranteed funding, but each next experiment has come closer to that goal. After thirty years of experimentation, and many lessons learned, the time seems ripe to grow lasting roots.

To this end, in Chapter 25 I will sketch my dream of launching a final experiment, this time with funding on at least a nine-figure scale, or ideally in the three comma range, that is a billion dollars or more. Three commas will do to form an endowment for a full-fledged research center that will serve as the start for setting up a major university. For comparison, in North America, there are a hundred universities with an endowment of a billion dollars or more, of which ten universities have an endowment of at least ten billion dollars as of 2017.

the role of play

Below I will continue my series of suggestions for playfully exploring the nature of reality. I have already sketched approaches that I labeled as playing Bohr, Galileo, and Nagarjuna. I will extend this series by introducing playing Descartes here in Chapter 21, playing Spinoza in Chapter 22, and playing Longchenpa in Chapter 23, before sketching my visions of possible playgrounds, past and present in Chapter 24, and future in Chapter 25.

So let's start with Descartes. Like Aristotle before him, poor Descartes has received tonnes of bad press lately. He is variously seen, often out of context, as wanting to separate body and mind, or as wanting to unify it in the wrong way, and in general as standing in the way of more holistic thinking.

If only Aristotle could see how the pendulum has swung back, given that Aristotle himself was accused of too much holistic thinking in Descartes' days. When scientist-philosophers of the seventeenth century tried to extricate themselves from the scholasticism of Medieval theologians, that still lingered in many academic circles, Aristotle was one of their favorite targets.

Fortunately, real progress in science is independent of such caricature description, and scientists are now finding ways of combining the best in the more analytic approach of Descartes and the more synthetic style of Aristotle's way of studying nature.

Meditations on First Philosophy

A few years after publishing his seminal work on mathematics, discussed in Chapter 16, Descartes wrote his "Meditations on First Philosophy", in which he gave a clear introduction to his core philosophical thoughts.

As a personal note, I read the Meditations not long after reading several of Husserl's main works, which had captivated me as soon as I came across them, when I was around forty years old. To put Husserl's thought in historical context, I first went back to Kant, and then even further back to Descartes. I started with Kant's Prolegomena and then Descartes' Meditations.

Both texts left a deep impression on me. And as so often is the case, reading an introductory text by an old master is such a different experience from reading later commentaries or summaries. It is like watching a famous painting as an

original, versus seeing a photograph or an attempt by someone to imitate the painting, a shadow of a shadow. While clearly delineated projections and explanations can sometimes form very helpful shadows, they still remain shadows.

opening lines

Right at the start of his Meditations, Descartes describes his motive for writing his discourse. Given that he lives in a time of many new developments, there is a great uncertainty of what can be trusted as reliable knowledge and what should be let go of as being no longer relevant. The way he approaches that problem reads like a computer scientist trying to debug a program for flaws that might have crept in right at the basic design of the whole code. You could say that his chosen task was to debug his world view.

To do so, he enlisted natural philosophy, in his days comprising science as well as philosophy, to provide certainty about matters of contemplation for those not sufficiently familiar with the latter. Or at least that is how I would describe it in the context of this book. In his case, he used the diction of his time: Soul for indicating the subject pole of experience, and God for pointing to what goes beyond subject and object. His opening lines are:

> "I have always considered that the two questions respecting God and the Soul were the chief of those that ought to be demonstrated by philosophical rather than theological argument. For although it is quite enough for us faithful ones to accept by means of faith the fact that the human soul does not perish with the body, and that God exists, it certainly does not seem possible ever to persuade infidels of any religion, indeed, we may almost say, of any moral virtue, unless, to begin with, we prove these two facts by means of the natural reason.

struck

Reading these lines, I was struck by how parallel Descartes' ideas really were to what I had been searching for, since I in vain looked for a Department of Reality Studies soon after taking up meditation at age 17, as described in Chapter 4, and since deciding to write a more in-depth alternative to the Tao of Physics at age 23, as I reported in Chapter 5.

When reading the Meditations at age 42, by the same author who had changed my world when I was 15 and read about his analytic geometry, I was struck to see in his Meditations a seventeenth century version of a Tao of Natural Philosophy. Very clearly, I recognized in his motive my desire to be understandable by my scientist colleagues, as I mentioned in Chapter 5.

The main difference was that Descartes wanted to be understood by infidels, who did not share his Christian values and convictions, whereas my target audience were my colleagues, who did not share my contemplative interest and experiences. And in both cases, he and I held out the hope that natural reason, his term, and a future science, my term, would open doors to show and share the deeper connections that we saw.

beyond empiricism

When I started to read the first of Descartes' six meditations, I encountered his argument that our whole life might be a dream. While I had heard that argument of doubt, introduced by Descartes, before, some time in high school, I had not taken it very seriously. But a quarter century later, reading Descartes' original writing, I was fascinated by the logic and clarity in which he developed his arguments.

In addition, by that time I was well aware of similar arguments put forth 14 centuries earlier by Nagarjuna,

whom I mentioned in the previous chapter. Viewing reality like a dream is just one of Nagarjuna's ways to point out the illusionary nature of what we experience; he also added reflections on water, mirages, and other instances of something seemingly real, that may turn out not to be. I felt cheated, that I had heard in high school about Descartes, but not about Nagarjuna!

Reading the second Cartesian meditation, I came across the famous "I think, therefore I am" argument, as Descartes' solution for his thought experiment of doubting everything. Again, though I had heard that expression many times, reading it in the original context made me immediately think about Nisargadatta, whom we encountered in Chapter 18.

In contrast to Descartes, Nisargadatta looked through the other side of the telescope, so to speak, starting with "I am" as the topic of years of contemplation, and finding a non-conceptual answer, beyond linguistic thinking. Like Nagarjuna, his Indian background invited him to go beyond the subject-interaction-object empiricism that Descartes took for granted.

It seems quite obvious, from either a Hindu or a Buddhist perspective, that the logical conclusion, starting with “(I) think” is “therefore there is thinking”. To impute a self-pole to the thinking is an extra hypothesis which as such is not necessarily empirically given. Among philosophers, David Hume had reached a similar conclusion. The later Heidegger made an observation along the lines of “thinking thinks”, i.e. no self needed. And continuing on a personal note, I myself intuited something similar, though much less clearly expressed, as a teenager, as I wrote in Chapter 20.

a global center of learning

In the last chapter of this book, I will discuss my dream of a truly global center of learning, not biased to mostly Western perspectives. No more cheating when discussing Descartes! Much as I appreciate him as an amazing genius

in many areas, including math and philosophy, it is time to put him in a wider context than the study of only the last few hundred years of only the Western part of the European appendix of the Eurasia continent.

I can picture a new kind of liberal arts college, in which philosophy will be studied globally, and not only in an armchair (or computer chair) way, but also experientially through the inclusion of contemplation classes and workshops. And in such a setting, I can envision a group assignment in a philosophy class, to write a stage play in which Descartes, Nagarjuna, and Nisargadatta meet each other in a bar, with a smoking section, and discuss the nature of the subject pole of experience. It is hard for me to think about anything more exciting, for a class assignment!

Such an exercise, in which one student would literally play Descartes, another Nagarjuna, and yet another Nisargadatta, or the bartender, or a passer-by, could make any philosophy class into a lab for trying out ideas from different cultures, comparing and contrasting them, and most importantly, experiencing them authentically.

Tilopa's six words

Among all the Buddhist texts that I have studied, one of my most favorite short sayings is known as Tilopa's six words. They are also known as Tilopa's six nails, because they really nail down what is most essential. They fit in this chapter, since they form a type of laboratory instruction for going beyond where Descartes left off. And this is the point where he and Nagarjuna and Nisargadatta, to mention two examples, a famous Indian Buddhist from long ago, and a very ordinary Indian Hindu who lived recently went further.

Tilopa's six words form one of the most minimal instruction sets for going beyond concepts. Here they are, in Ken McLeod's translation:

don't recall
don't imagine
don't think
don't examine
don't control
rest

These are translated into English from a Tibetan source that is in turn a translation. Tilopa was an Indian tantric Buddhist teacher who used Sanskrit, or perhaps Pali, but the original text has been lost. And in case you noticed more than six words: in Sanskrit, negation is expressed by adding a 'not' ending, as in recall-not, which counts as one word.

Ken McLeod also offers a more elaborate paraphrase:

Let go of what has passed
Let go of what may come
Let go of what is happening now
Don't try to figure anything out
Don't try to make anything happen
Relax, right now, and rest

Since I first came across Tilopa's six words, a bit more than fifteen years ago, I have been practicing with them regularly. The more familiar I became with them, the more their sense and meaning became alive for me.

The central idea, as far as I understand it, seems to be connected to dropping allegiance to a view of time as being a linear, one-dimensional, past-present-future affair. When our mind is idling in inner dialogues, we find ourselves shifting across all three time aspects, recalling the past, imagining the future, and thinking about the present. The first three words of Tilopa tells us to drop that habit as much as we can.

The next three words repeat the same injunction in the same order but even more forcefully. In short, the six together seem to say: don't dwell on the three times, and definitely don't try to tinker with them! After the warning not

to recall, imagine, or think, the stronger version is to not examine the past, not to control the future, and not to resist whatever the present has to offer.

In this last sentence I replaced Tilopa's last word by "don't resist", instead of "rest", to make it all more symmetric as negations. After all, as a scientist, I like to tinker with what draws my attention. And given that I don't consider myself a Buddhist, as opposed to other types of contemplatives, I took the liberty to play with the specific phrasing of Tilopa's words, something that may or may not have been encouraged in the Kagyu School of Tibetan Buddhism that goes back to Tilopa – depending on the strictness of the particular teacher, presumably.

To my delight, when I asked a professional Tibetan translator, Thomas Doctor, what he thought about my interpretation, he told me that it was actually quite close to the Tibetan word that is generally translated as 'rest'. When I asked him how he would translate that word, he paused and thought for a while, something he often does in the middle of a discussion, which is part of his charm. He then responded with 'leave as is', in the sense of "leave (everything) as (it) is".

We both concluded that 'leave as is' has significant overlap with 'rest' as well as 'don't resist'. Since that time, I have been playing with two forms of practice, centered around Tilopa's words: one in which I repeat all six words a number of times, and one in which I just focus only on Tilopa's last word, in the form 'leave as is'.

Meanwhile, I can't count the number of times that I've been about to get annoyed with something or someone, when remembering Tilopa's last word made me smile and defuse my reaction. And, for full disclosure, the number of times where I only remembered Tilopa's last word after the fact, having gotten annoyed already, may well be even more countless. (^_^)

* * *

Chapter 22. Playing Spinoza

What can we do, right here and now, to explore the relationship between mind and world, even if we are not an expert or a seriously dedicated amateur in any of the areas that directly relate to the core questions involved? Well, a whole lot!

There has never been a better time to jump in, given the easy access to information, both theoretical information on the internet, as well as pointers to where you can find groups engaged in more experiential explorations, from meditation groups to groups that focus on yoga, martial arts or other such training.

As with any adventure, you may of course want to be careful in picking your sources, and especially in choosing groups to join; that goes without saying. As usual, a bit of street smartness goes a long way. If you are setting out to climb a mountain, you want to be careful in choosing the ropes and other equipment to bring with you. In exploring your mind, too, reading or listening to a bit of consumer advice may not be a bad idea.

Any individual can now easily study the wisdom and insight and inquiries recorded by some of the great minds throughout history, around the world. In this chapter we will look at more European sources, and in the next chapter we will move to Asian sources. The two chapters following those will focus more on community efforts.

Seneca

While in high school in Holland, I had the good luck to learn classic Greek and Latin. Greek was fun, starting relatively quickly with Homer and working our way up to reading Plato. I remember how thrilled I was reading Socrates' defense at his trial in Plato's original Greek. We

happened to have an engaged and engaging teacher, too, which of course also makes a lot of difference.

Latin was less interesting, reading a string of war stories from Hannibal's invasion of Italy to Caesar's crossing the Rubicon one and a half centuries later. But in the last year of high school I was finally free to choose my own author to study, and my choice fell on Seneca.

It was such a breath of fresh air to read Seneca's letters to Lucilius, a much younger friend to whom he gives advice about philosophy and life in general. These letters were written during the last few years of Seneca's life, and just reading them, slowly because I had to translate from Latin, made me feel as if I were in a conversation with Seneca myself.

While reading, there was a calmness in the air, a sense of serenity that I still find difficult to put into words. As if the everyday chatter disappears, like leaving city life behind and finding yourself in front of a calm clear lake in a pleasant forest. Through the everyday events that Seneca describes and analyzes, he shares the gist of his Stoic outlook, not in an abstract intellectual way but through the concrete narrative surrounding each event.

I remember walking on the city streets, near my high school, viewing the busy life around me with the eyes of Lucilius, as he must have done a couple thousand years earlier, after reading yet another letter addressed to him by Seneca telling him to look beyond business to his inner sense of silence, recognizing and realizing it in the outer world as well. And I felt connected in a timeless way with both him and Seneca, as if a mantle of peace had descended. Romantic? Sure. Real? Very much so.

Spinoza

Around that time, I also encountered the writings of Spinoza. Reading various texts, first about Spinoza to get a

sense of his way of thinking, and then Spinoza's own writings, I had a similar reaction as what I felt while reading Seneca. The best way to describe it is that something changed in the air, or atmosphere, as soon as I would open a book by Spinoza. As if the air simultaneously became more soft and almost milky yet clear and transparent.

Of course, the content of what both writers wrote I found fascinating as well, but even more than the content, the spirit of their inspiration and motivation was what especially attracted me: Seneca's search for a kind of algorithm or recipe for a peaceful life; and Spinoza's attempt to find a truth according to which to life live, a truth as certain as that of mathematical derivations from a few plausible initial axioms. I was not sure to what extent I was willing to buy into those assumptions and the views that they derived for themselves from their assumptions, but I very much enjoyed trying them out, living for a while following their examples, tinkering with the practical effects of their preferred lifestyle.

Whatever I can write about those hours spent reading Seneca and Spinoza will sound paradoxical, because what I experienced just didn't fit into my normal way of reading and living. Both of them gave the same advice, namely to withdraw to some extent from the world, at least for a few hours a day, enough to find a deep stillness that eludes us in the middle of the hustle and bustle of everyday life. It went very well with my budding meditation practice, reading, reflecting and sitting all reinforcing each other.

In fact, reading either writer was for me a direct form of contemplation, stilling the overly conceptual modes of my mind and letting more intuitive aspects of mind come to the fore. That for me was more important than the actual meaning of the words I read, of which I now remember far less than the wholesome effect that reading those writers had on me.

timelessness

I do remember the beauty of Spinoza's reasoning, where he tried to give mathematical form to what he perceived to be central to the nature of reality. While I don't accept his derivations as giving any direct proof of what he tried to say, I cherish them as direct expressions of his own inner experience of the nature of reality.

Spinoza's calm confidence in a mathematical certainty underlying the ever changing momentary appearance of the world was what attracted me. His confidence is exactly the opposite as the make-believe certainty that populist politicians and expert con artists display. And I feel that what Spinoza saw went much deeper than what he could convey in language, pointing to a reality deeper than words. I'm pretty sure this is the reason that he never was able to finish his essay ‘On the Improvement of the Understanding’, in which he described ever more direct forms of knowing.

It is not so much what Spinoza said but more how he said it and how he derived what he said. His expression 'sub specie aeternitatis', which roughly translates as 'in the light of eternity', or I think better 'in the light of timelessness', captures the Stoic impulse of going beyond the linear past-present-future one-dimensional view of time, as I have alluded to at the end of the previous chapter.

awe

I am not alone in my sense of awe for Spinoza. The way that Spinoza identified God with Nature resonated with many scientists, including Einstein. When asked whether he believed in God, Einstein’s response was "I believe in Spinoza's God."

Einstein's appreciation for Spinoza went deep, beyond just a purely rational affinity. He even went so far as to write a poem about Spinoza, which starts, in English translation, with:

How I love this noble man
More than I can say with words.
Still, I fear he remains alone
With his shining halo.

Another Einstein quote expresses a similar sentiment: "That deep emotional conviction of the presence of a superior reasoning power, which is revealed in the incomprehensible Universe, forms my idea of God."

Husserl

Even though I have no idea what underlies my intuitive sense of awe, when reading anything that Spinoza wrote, I do have a few more data points of other writers whose works triggered a similar sense for me of being lifted out of time, so to speak, to what feels like a different plane with a sense of timelessness. I really struggle to find words here, which is odd, since the experience itself is so tangible.

Another philosopher who induced a similar certainty for me was Husserl, whom I encountered more than twenty years after I found Spinoza as I already mentioned in Chapter 6. Interestingly, Husserl too started with a love of mathematics, and the first book that made him famous, written when he was about forty years old, was titled "Logical Investigations", in which he introduced his philosophy of phenomenology.

What I try to point at is the kind of certainty that comes with going through a mathematical proof, step by step first, but then looking at the whole body of the proof and 'seeing' all at once that the proof is correct. There is a rational element in first convincing oneself of the correctness of each step. But the 'direct seeing' of the whole proof is connected with a different kind of rationality, more akin to contemplation or something straddling both.

I get the impression that it was more this kind of rationality that powered the eighteenth century

enlightenment, rather than the dry and lifeless rationality as we nowadays understand the word. I sense it was also close to Husserl's rationality.

three ways of understanding

Over time I have come to realize that, for me at least, there are three ways or phases in understanding a mathematical proof, each one going deeper than the previous one. And while I can point to these three most easily in the case of mathematics, I see a clear similarity with levels of understanding in several other areas as well.

The first and easiest way to understand a proof, let's say Pythagoras' theorem, is to follow the proof step by step, either in algebraic or geometric form. When done carefully, one can declare that one trusts the theorem to be correct, having verified each step leading to the final result.

The second way to understand a proof is to 'see' or 'grok' the whole Gestalt, for lack of a better English word. In the case of Pythagoras' theorem it can be a geometric form of 'getting it', when for each side of a right triangle one draws a square and constructs a picture that makes it obvious that the square of the length of the hypotenuse of a right triangle is equal to the sum of the squares of the lengths of the other two sides of that triangle. Or it can be an algebraic form, where one glances at the symbolic derivation and 'sees' how it shows the same conclusion.

The third way is to try to imagine how you yourself could have found a proof, had you never seen one yet. This requires getting a good grasp on the landscape of mathematical objects and forms of reasoning within which the proof lives. On those occasions where I reached this third level of insight, it typically happened after trying repeatedly to explain the proof to someone else and/or teaching the proof to a class. Eventually, I would not only 'see' the body of a given proof as a whole, but I could also see how that body was 'born' out of the surroundings of the

proof, out of the elements lying around there. Interestingly, it was the wide variety of ways in which students managed to misunderstand the proof that shone a lot of light on the ‘surroundings’ of the proof in the landscape of mathematics by charting some of the many ways one could go astray and get lost in a derivation. The cliffs, bushes and swamps next to the path to a proof put that path more in perspective.

seeing

I've never seen or heard anyone else mention this triple structure of understanding, and I'd love to talk with an educator who resonates with this idea, and who may well be able to point me to the literature where it probably has already been explained more clearly than I have tried to do here.

The third way typically takes much longer, just like the second way can take much longer than the first one. But just as the second way is more satisfying than the first way, the third way is even more satisfying and has always given me the idea that I 'finally' really understood what the proof was about.

I have mentioned before how I perceive a similarity between mathematical 'seeing' and contemplative 'seeing'. Spinoza's and Husserl's philosophizing for me straddles the two in a very direct 'gut feeling' way. This gives me a strong motivation to try to assemble a community of peers to explore these parallels as I will describe in the last chapter of this book.

I am looking forward to playfully exploring ways of knowing, based in mixed forms of 'seeing', in what I am happy to call 'playing Spinoza', following the other labels of playing that I have introduced in earlier chapters.

outer space

To conclude this chapter, let me share an example of 'seeing' as opposed to just understanding a concept or situation. It is a single paragraph that I found on a blog, a few years ago, but it seems that that blog has disappeared, and googling gave me no results. So I'm resurrecting the text here, in gratitude to the, for me anonymous, writer, who wanted to convey his or her vivid sense of outer space:

> In your everyday life, you probably don't give much thought to outer space. But the reality is that you're surrounded by it on all sides. If your car could go straight up, you could drive to space in about an hour, and without risking a speeding fine. Down here on Earth, we're a bit like well informed goldfish in a bowl -- we might know on an intellectual level that there's a lot more to the universe than our little habitat, but we can't really imagine ever going there, or any use for it. It's just an interesting curiosity for goldfish "astronomers."

Even though I have been an amateur astronomer since I built my first telescope at age twelve, and later a professional astronomer since I got my first postdoc job sixteen years later, reading this text helped me to 'see' outer space even better than I had done so far. There seems to be no end to falling deeper into 'seeing'.

* * *

Chapter 23. Playing Longchenpa

So far, I have invited several historical figures to join us in this narrative as role models for us in playing-as. In this chapter I will invite the last one, my most favorite role model, Longchenpa, a Tibetan Buddhist teacher who lived in the fourteenth century.

Longchenpa systematized and summarized many of the texts that had accumulated in Tibet since the introduction of Buddhism from India six centuries earlier. I was introduced to him and his writings when I visited Tarthang Tulku's Nyingma Institute in Berkeley while I was still a graduate student. As soon as I read some excerpts of his writing, I was hooked.

What could it mean to play Longchenpa, as a short-hand expression for exploring the unity of mind and world, not in a future academic project but right here and now in our own lives? Longchenpa's view of reality might be summarized in the most pithy way as "Nothing, yet there". How to live in empty openness, embracing all that appears, yet in total suspension of judgment as to its ultimate reality and characteristics?

from matter to experience

Let us start at square one, with our normal reality, where we find ourselves embodied in a material world, among other people and animals, plants, and non-living things. All matter and energy is spread out over the universal stage of space and time, pervading the Universe. So far, so good.

But as we saw already in Chapter 6, anything we know about matter is given to us through our sensory perception and interpretation thereof, in short, through our experience. When we see a table, we interpret our visual experience as a material object. And when we can touch it too, our tactile experience confirms for us the presence of the table.

But as we know from dreams, movies, or other forms of virtual reality, it is possible to 'fall into' a seemingly material reality which turns out to be woven out of complex sets of induced experiences. This implies that we have a choice, when watching a movie: we can watch it as if the story was real, falling into the story, identifying with the players, or we can watch it as a story, remaining more aware of the fact that our senses are manipulated by the visuals and sounds that make up the movie.

Similarly with dreams, where typically most people don't realize that their dream experiences don't correspond to a material world, until they wake up and remember the dream. There, too, it is possible to become aware of the dream as a dream, a phenomenon called lucid dreaming, as was introduced in Chapter 11. And in Chapter 12, the term 'lucid living' was introduced: to live our waking life while being aware that all we deal with is experiences.

Note also how we can experience non-material aspects of our reality. We can feel frustrated by laws we don't like, and we can enjoy the friendship of someone close to us; we can feel responsibility, and we can worry about our finances or our reputation, all aspects of experiences that are very real, even though they are about intangible aspects of life that play out in the material world but that are not itself material.

from experience to appearance

Having switched from considering ourselves to live in a material world to viewing our world as given as a virtual reality, composed of experiences that don't necessarily correspond to material objects, it may take some practice to stabilize in that awareness. But once we get used to that new perspective, we can go one step further.

For there to be an experience, we need an experiencer who experiences something that is experienced. A seer sees the seen, a hearer hears what is heard. Experiences

are typically formed in a subject-interaction-object triad, as we saw already in Chapter 1. But how about dropping, or just putting on hold, our belief in the existence of a subject?

What is left then is sheer appearance. Trees and clouds and birds still appear, but are no longer claimed by an experiencer as being experienced; they just appear.

This idea may be difficult to grasp at first, but it is really very simple -- which may make it hard to 'get' at first, especially we are now de-emphasizing the notion of a subject who is supposed to 'get it'. :-)

It may be best to practice initially with a single object. There is a tree, a material object made out of wood and leaves, juices inside, and probably also insects. You can spend a minute or more checking how you sense the tree as a material object, consisting of various material components.

Then make a shift, and consider the tree as an experience, your experience, which doesn't necessarily need an external object; it could be a hologram, or even a dream image or hallucination.

After a while, make a second shift, and consider the tree as an appearance. No assembly required, by an imputed self. Just remain aware of the fact that something appears, something that is typically called a tree. That is all.

from appearance to presence

At this point, can we go further? Having put on hold our habitual belief in a material reality, first, and then our belief in the need for there to be a subject to have an experience, we are left with appearance. What can we say about appearances, as such, as forms of sheer appearance, without a sustaining world at the object side and without an experiencer at the subject side?

All that is left then is that appearance appears. That is all. Everything we normally would add, on the level of matter, or even on the level of experience, has dropped away.

But wait, there is still something there. There is the presence of appearance. There is not nothing. There is appearance. Longchenpa's 'nothing, yet there'.

Becoming aware of the presence of appearance, we have made a third shift. We have moved from matter to experience to appearance to presence, namely the presence of appearance. Or in full: the presence of appearance of experiences of a material reality.

from presence to appreciation

But is that all, is there really nothing left to do? Is this the end of the road? Is the presence of appearance the last word?

Well, let's see. Having dropped any allegiance to any belief or judgment regarding what the appearances are, and having settled for their presence, there is still a choice left. It is possible to appreciate their presence.

This is one relatively simple way of playing Longchenpa: to appreciate the presence of appearance.

You may be surprised, to see how your world can change, relatively rapidly, by playing with the four shifts suggested here. And it may give you an enhanced appreciation for the intimate way that mind and world are connected, any moment of your life, and how they can be seen as grounded in a form of open presence.

Garab Dorje's three words

Longchenpa's most profound teachings concern Dzogchen, considered by the Nyingma School of Tibetan Buddhists as the most direct approach to the nature of reality. Dzogchen is said to go back to Garab Dorje, who at the time of his death summarized his teachings for his main disciples in what is called Garab Dorje's 'three words', or also 'three statements that strike the vital point'.

Unlike Tilopa's six words, each 'word' here is actually a short sentence in Tibetan. The key words in each sentence can be rendered as:

Directness
Decisiveness
Confidence

The first statement points to receiving an initial direct introduction to the nature of reality. The second one points to the follow-up of decisively applying that direct insight in one's life. The third one points to the complete confidence that comes with living in and as the nature of reality.

This is my best attempt to summarize the three words in one short paragraph. Like with the six words of Tilopa, these three also grow on you over the years if you seriously contemplate them. I found it helpful to view these three words geometrically, as 0D, 1D, and 3D. The initial pointing out happens in an instant, and so is zero-dimensional. The decisive follow-up feels to me more one-dimensional, like a path one follows with full determination. The confidence is then more three-dimensional, covering the whole world.

It is said that the entry point into Dzogchen, the first statement, can only be transmitted by a qualified teacher. For me this happened for the first time in the workshop that I attended, given by Namkhai Norbu, as I described in Chapter 10.

* * *

Chapter 24. Stanford, Kira, WoK, PaB, YHouse

Progress in science is clearly the result of a community effort. Scientific research takes place in smaller and larger groups at universities and private corporations, in government labs and independent research institutes. In addition, there are a large number of national and international scientific organizations that organize conferences, publish journals, and in many other ways coordinate and promote science.

In contemplation, too, there have been, and are still ongoing institutional efforts. Christian and Buddhist monasteries go back to around the fourth century. The Nalanda Monastery in India was also a University, with about 2,000 teachers and an estimated 10,000 students. It was centuries older than the oldest European universities.

In comparison, there is rather little joint effort going on between groups of scientists and contemplatives. Until recently at least, academic studies of contemplation generally suffered from the fear of 'going native', as we saw in Chapter 6. Meanwhile, for centuries scientists did not see much reason to study contemplation, and neither did contemplatives show much interest in science.

Fortunately, things are now changing, albeit slowly, and some tentative contacts are being forged. However, most of these are focused on applications of meditation to medicine and therapy. Examples are brain studies of meditating monks and examinations of the use of meditation to calm the mind. While an encouraging start, it is only the very beginning of a dialogue.

what contains what?

It is high time to go much further and ask more pertinent questions that concern the foundations of both science and contemplation. My favorite question is a very simple one, which can be summarized as "what contains what?"

Is the Universe that natural science studies the ultimate container for everything else, including the surface phenomena of a small planet called Earth, a speck of dust that gave rise to life four billion years ago and to humans and human culture, including science and contemplation? This Universe-as-container is the implicit assumption of the vast majority of colleagues whom I have encountered in any area of academic studies.

Or is Reality something very different, perhaps much larger or wider in ways that go beyond the current tools of scientific thinking? It is easy to find some simple models for this assumption, either borrowed from science or from contemplation. For example, the whole Universe as we know it could be part of a huge computer simulation, something that has recently been taken somewhat serious by at least a few prominent scientists. Or some contemplative principle, God or Tao or Emptiness, could be the ultimate truth, with our Universe having the character of a dream-like appearance within a realm that is much vaster, perhaps forever ineffable.

Or, as I prefer to think, Reality will be found to exceed by far any model or concept or theory that any scientist or contemplative has ever put forward, including what has been written about 'what goes beyond concepts'. Putting on my scientific hat, and looking back at the history of science, I know that any successful form of unification has led to an insight that turned out to be vastly more profound that the views it tried to unify.

In other words, what came before unification were shadows on the wall, mere projections of a much larger edifice. And in my usual conservative approach, I would put my bets on history repeating itself here as to the answer to the question of 'what contains what'. I bet the answer will be something beyond our currently wildest dreams. Yet, without asking the question, we are unlikely to stumble upon an answer, wild as it may be.

partners in mischief

I have been asking 'what contains what', for me most burning question, ever since I started to explore the world of contemplation back in my high school days. This question is what made me study astrophysics as well as particle physics. Alas, as I reported in chapter 4, neither fellow students nor teachers took my question seriously.

In fact, it took me a quarter century before I finally found the first two partners in mischief, willing to seriously entertain that question. Here 'seriously' means spending years intensely pondering its meaning and a variety of possible solutions.

Roger Shepard, a leading cognitive psychologist, now emeritus professor at Stanford, was the first of these two. I met him in 1994, in an unlikely way, as I described in Chapter 19, and I mentioned some aspects of my joint research with him in Chapters 12 and 14. Steven Tainer, a meditation teacher and contemplative in Berkeley, was the second. I met him in 1996, as I mentioned in Chapter 10. Already on the day that Steven and I first met, we told each other that our most burning question is 'what contains what'; in fact we both used the exact same phrase.

More recently, to my great delight, I am running into more and more people who share my fascination with science and contemplation to the degree that the first two, Roger and Steven, already did when I met them. Some of these I have met by chance or by hearsay. Others I have met through

my ongoing attempts at community building, with the ultimate aim to establish centers of learning in which scientists and contemplatives can engage in joint research into the deepest questions about the nature of reality.

In this chapter I will present brief vignettes of five of my most recent attempts at such community building. The first one I started upon meeting Roger and continued with both Roger and Steven two years later, and in different forms with several others soon thereafter. The next three, Kira, WoK, and PaB, were successive stages that followed, directly or indirectly, from our initial Stanford activities. After briefly describing those, I will summarize my latest stage, YHouse, following brief intermezzos about my involvement with the establishment of the Earth-Life Science Institute in Tokyo (ELSI) and the ELSI Origins Network (EON), together with a brief interlude called MANYFOLD.

Finally, in the next chapter I will switch from past to future, laying out my dream of building a permanent center of learning, focused on the study of the nature of reality.

Stanford

The first of these five projects, all of which centered on the relationship between mind and world, took the form of a two-year series of weekend workshops at Stanford University. These were made possible by a grant from the Alfred P. Sloan Foundation for a research project titled "Co-emergence of Our Knowledge of Mind and World." For summaries see:

https://www.ids.ias.edu/~piet/act/nat/limits/sloan9495.html

https://www.ids.ias.edu/~piet/act/nat/limits/sloan9596.html

The dozen or so meetings that I organized with Roger at Stanford were formative for me, in showing that it was actually possible to share my most burning interests with others, something I by then had despaired being able to do. I organized the meetings in the same format that I had

developed over the preceding decade in my interdisciplinary projects, first while on the faculty at UC Berkeley and soon thereafter in my current position at the Institute for Advanced Study in Princeton.

The recipe was very simple. Ingredients: take six or seven of the most interesting people you can find, together with a relaxed environment, large enough to host them. Method: add people to environment, simmer, stir, repeat. Caution: make sure to refrain from adding any specific agenda or goal to prevent premature coagulation.

Kira

After completing the two years of workshops at Stanford, Roger, Steven and I joined forces with philosopher of science Bas van Fraassen, at that time a professor at Princeton University, and physicist Arthur Zajonc, then professor at Amherst College, before he became the president of the Mind & Life Institute. In 1997 we started the Kira Institute, where the word kira was borrowed from Japanese 'kira kira' for the sound of a twinkling star; taking our cue from a famous Zen koan, we used kira as the sound of half a star twinkling.

The Kira Institute was very active from 1997 to 2002, organizing five two-week summer schools at Amherst College with the support of a grant from the Fetzer Foundation, and numerous weekend workshops of the type we had pioneered at Stanford. After a more quiet period of several years, Kira became active again for a few years in the virtual world of Second Life, starting on 2008. See the Kira website: http://www.kira.org/

Ways of Knowing

Following half a dozen exciting Kira years, in 2002 Steven and I took stock of what we had learned. Much as we had enjoyed the ten weeks total of summer school

teaching, the dozens of weekend workshops, as well as the large number of Kira salon evenings in New York City in the late nineties, we were still not satisfied. We wanted to make an even deeper inroad into the 'what contains what' question, more than had been possible in both the smaller and the larger Kira group gatherings.

We decided to try a more extreme collaborative format. For several years, every three months we would spend three weeks working together, just the two of us. After some twenty visits, ten in Berkeley and ten in Princeton, for the equivalent of more than a year of full time work, we started a website called 'Ways of Knowing', WoK for short. True to form, the top picture on our home page showed the bottom of a wok; see http://www.waysofknowing.net/

After posting some of our own writings as well as dialogues in 2006, we started an on-line community, experimenting with various media. Initially we used the WoK website, where we posted contributions from several members of the WoK community. In 2007, I started to experiment with giving a lecture series in the virtual world of Videoranch, having been invited there by its founder Michael Nesmith, known originally as a member of the pop rock band the Monkees.

I got to know Nez, as he is known for his friends, when both he and I submitted a contribution to John Brockman's Question Center on John's Edge website for New Year's day in 2006. To our happy surprise, we discovered that both of us had written about timelessness in response to the question that year *'What is your dangerous idea?'* That year we met a few times in New York, where I lived, and in Monterey, where he lived. In 2007, while visiting him, I gave what was intended to be just a single popular talk about astrophysics. Soon it developed into two parallel series of talks about astrophysics and contemplation, topics of shared interest between Nez and me.

Soon it turned out that the virtual world of Qwaq was more suitable for in-depth conversations, fun as Videoranch

had been as a place to hang out (I still smile whenever I remember the unwritten rule to celebrate something, anything, with a pink flamingo dance: all avatars would on cue change into pink flamingo). In Qwaq we held regular meetings for a couple years, for much of the time weekly, and for at least half a year on a daily basis.

Play as Being

Much as I had enjoyed both Videoranch and Qwaq, I realized that we could not reach many people in the tiny communities that they served. In contrast, the virtual world of Second Life had grown a user base of around a million, a completely different league to play in. After a year of experimentation I decided to take the plunge in the spring of 2008 by kicking off two independent activities, one in science and one in contemplation. I never tried to bring the two together since I felt that in those days, more than ten years ago, the *Zeitgeist* or 'spirit of the time', wasn't quite ready for that yet.

The first one was MICA, short for Meta Institute for Computational Astrophysics, which I co-organized with George Djorgovski, professor of astrophysics at Caltech. It was the first grass roots scientific organization in Second Life. While many of the leading universities had opened virtual campuses there, most of those were like ghost towns, organized by university bureaucrats with little experience in Second Life, and with little active support from faculty and students in Real Life. In contrast, George and I, immersed naturally in both Second Life as avatars and in Real Life as active researchers, were drawing regular crowds in our MICA building, designed by a professional architect Mara Breunesse. For several years we held regular seminar series, always surprising the audience: one day featuring a graduate student talking, the next week a Nobel prize winner. In this we copied the brilliant physicist Luis Alvarez, who still held his weekly meetings at his home in Berkeley in the mid eighties, when George was a graduate student and I was a junior faculty member at UC Berkeley.

The second organization I founded in Second Life I called 'Play as Being', PaB for short. Still ongoing after more than a decade, PaB hosts daily meetings, where people come together to chat and discuss many different topics. There are also more specialized meetings, focused on particular subjects such as dreams or discussions of specific books or movies. The basic idea of PaB was, and still is, very simple: to drop what you have in order to see what you are. At the end of this chapter, you can find some instructions. See https://wiki.playasbeing.org/ .

the Earth-Life Science Institute

After two decades of extensive experimentation, described in the four initiatives listed above, the time had come to switch from a footprint in a virtual world to one in the real world. Following my involvement with PaB, mostly during 2008--2011, I switched to a different topic in 2012, namely the study of the origins of life. This is the topic of the second of the three biggest surprises, as I discussed in Chapter 15: the origin of the Universe, life, and awareness.

Having worked on the first surprise during my PhD in my research on the structure of the Big Bang and having studied contemplation intensively starting already ten years before my PhD, I found a great opportunity in Tokyo to finally study the, for me, still missing surprise, namely the origins and nature of life. In 2012 I was asked to be one of the Principal Investigators for a grant proposal to the Japanese government, for a one hundred million dollar grant over a period of ten years, to start a whole new research institute. There was an intense competition among all of the universities in Japan, given that only three such grants were going to be awarded within a five year period of time.

That year we worked hard on putting together a strong organization of leading researchers in the main fields of importance for the origins of life within the context of the origin of Earth. Our work paid off: we were one of the

winners, and by the end of that year, we established the Earth-Life Science Institute (ELSI) at the Tokyo Institute of Technology, the Japanese equivalent of MIT. See http://www.elsi.jp/en/ .

Given my life-long experience in conducting and managing interdisciplinary research, I set myself the task to structure ELSI as the kind of dream environment that I've had in mind for decades, as the ideal place to foster collaborations across disciplinary boundaries. Central to that dream was gathering different experts to work together under one roof, not for a weekend or a week-long meeting, but for years on end. ELSI gave me the first chance to realize that dream.

the ELSI Origins Network

While spending a few months a year helping to build up ELSI, I realized the need for a global network, in order to complement the local achievements in Tokyo. For that purpose, I applied for a five million dollar grant from the John Templeton Foundation over three years, to establish EON, the ELSI Origins Network. The application was successful, enabling us to hire joint postdoctoral fellows in collaborations with other institutes worldwide and organize numerous workshops at ELSI while also hosting many visitors at different stages in their career. See http://eon.elsi.jp/ .

EON, running from summer 2015 to spring 2018, gave me the opportunity to experiment even more freely with my interest in origins questions, compared to the main research in ELSI, where disciplines were naturally lined up in a mostly one-dimensional way. From *astrophysics*, describing the origin of the Earth, to *geophysics*, keeping track of major changes on Earth during the first few hundred million years after its formation, to *geochemistry*, analyzing the growth in complexity of the Earth's environment during that time, to when *biochemistry* took over at the point where life began,

the chain of disciplines finally led via evolution to *biology* now dominating the planet through its biosphere.

In contrast, I was interested more in a second dimension, orthogonal to the first, a meta-dimension in complex systems research, involving Artificial Life and Artificial Intelligence (ALife and AI), of the type I had encountered at the Santa Fe Institute, where ALife had been pioneered twenty years earlier. With the money for EON coming from a private foundation rather than from a government grant, it was easier for me, as the recipient of the grant, to hire and invite a few researchers interested in questions going beyond the nitty-gritty of the main chain of research under full steam at ELSI.

One of those maverick minds was Caleb Scharf, director of astrobiology at Columbia University and also a prominent popular science author and speaker. He and I organized the first EON workshop at ELSI in the summer of 2015. When I first met him there in Tokyo, it turned out that he was living in walking distance from my place in Manhattan. Talk about a small world! Soon after, we started meeting in bars somewhere between our two apartments to begin scheming about ways to copy the success of ELSI/EON in our own neck of the woods.

MANYFOLD

The most straightforward idea was to try to establish a new research center at Columbia University as a further extension of the very successful Astrobiology Center that he had established there a decade ago. And the topic area that we were most interested in was the third of the three surprises: after the origins of the Universe and of life, the origin and nature of awareness. We soon came up with a name for our new initiative in a somewhat tongue-in-cheek acronym: MANYFOLD, for the Metropolitan Area of New York Framework for the Origins of Life and Death.

However, after half a year of holding regular meetings at Columbia, followed by our first MANYFOLD workshop, we started to realize how difficult it was going to be to start a broadly interdisciplinary initiative at a university in the US. While some key scientists in the administration of Columbia University were very interested in our ideas, encouraging us to further unfold MANYFOLD, we began to get a sense of the enormity of the turf battles that were awaiting us. It was at that point that I saw very clearly the uniquely Japanese nature of ELSI, which we were trying to emulate.

In the US, and in most European countries as well, it is an uphill battle to try to get two existing departments to work together in starting an interdisciplinary research center. It can be done, but it ain't easy, because in each department there will be plenty of researchers who can become concerned that funds for the new center may lead to a diminishing of funds for their own research. And this is indeed a real danger, which should be taken into account. But if this kind of zero-sum thinking becomes a knee-jerk reaction, it will hinder any attempt to think out of the box, into a win-win situation, where everybody can gain through the influx of new funding.

Trying to get three departments, and their chairs and faculty members, to agree on setting up a collaborative research institute is even far more difficult. When Caleb and I began to realize the enormity of the challenge to set up a research institute comprising at least *half a dozen* disciplines, we foresaw years of being embroiled in a struggle that would be only secondary to our goal. But what was the alternative?

YHouse

In Tokyo, life had been so easy. When the Japanese government had given us a new building for twenty-five million dollars and a pot of gold worth seventy-five million dollars in that empty building to spend on interdisciplinary research, lo and behold, nobody objected! The difference

between the more feudal Japanese system and the more egalitarian US system in this particular case comes down in favor of the Japanese system, if the objective is to establish a truly interdisciplinary research center. Ideology sometimes gets in the way of practicalities.

The upshot was that we decided to start a not-for-profit center, not connected to any existing university, early in 2016. We continued to gather more collaborators, during the MANYFOLD phase as well as afterwards. The result was YHouse. When we came up with the name, each of us had a slightly different explanation of what it could mean. My preferred choice was: Y do we have the convictions we have? This "why?" question can lead to the discovery of so far unacknowledged obstacles in the form of inherited prejudices against looking at world and mind in new ways. See https://www.yhousenyc.org/ .

The main theme of YHouse is the study of awareness, an umbrella term for studies of the mind, including consciousness, cognition, and intelligence, terms that tend to acquire more narrow meaning in specific disciplines. YHouse has been very successful in organizing popular talks in different venues, such as the Rubin Museum and Caveat, as well as other places in Manhattan. And starting in 2017, for almost a year, I wrote a weekly blog post for YHouse, Lucid Living, which gave me the inspiration to write this book; see https://yhousenyc.org/lucid-living .

While we had many interesting scientific exchanges during the first few years of YHouse, including a study group in phenomenology, it was not easy to maintain a steady series of offerings using mainly volunteers. This led us to consider alternative structures, with more stable funding, based on an endowment. This will be the topic of the next chapter.

playing as Being

Here are some of the instructions that I introduced on the PaB website, mentioned above, to explain what I had in mind with the expression "play as Being". When we say "I am a woman" or "I am a carpenter", we really mean "my gender is female" or "my profession is carpentry." These attributes are something we have. What we really are is something altogether different.

Can we liberate ourselves from overly identifying with these labels? Without denying or changing any identification we hold, like gender, job, etc., can we wear them lightly, like comfortable clothes, rather than sticking to them like a skin? Can we view all 'am' as 'have' as if all the 'am' layers are just so many layers within an onion with no unquestioned solid core?

This begs the question what we at bottom could be. Without having the foggiest idea, we could at least give it a label, such as Being, while leaving its meaning open. There are parallels and differences between this type of exploration and some contemplative exercises. In Taoism we may try to see everything as given in and as the Tao. In monotheistic religions we may see everything as given by a single God. In Buddhism we may consider everything as given in and as emptiness or suchness. It may be helpful to start with any of those perspectives, but even so, it would be best to keep an open mind as to how exactly Being may be related to one or more of those notions.

After playing a bit with shifting between what we consider ourselves to have and to be, we can imagine all that appears for us as just so many presentations of Being, in the same spirit as playing Longchenpa in the previous chapter: appreciating the presence of appearance as Being.

Here is a suggestion, if you feel adventurous, and want to explore the have/be distinction further for yourself. For at least a few days, how about we taking an hour or more during which we impose a one percent time tax on all our

activities. Roughly each quarter of an hour, let's spend about nine seconds on this type of exploration (there are 900 seconds in 15 minutes, hence the 1% tax). During this time, take a full breath, relax, and focus on considering yourself as Being. In other words, play as Being. If you do this for two hours a day, it will only take you 2x4x9 seconds, just a bit more than one minute a day, not a big chore!

It may be that, when continuing this for a few days, you think more about playing as Being also in between the 9-second breaks, and that in turn will make it easier to pick up the thread swiftly during the next 9-second window. Even if you do this for only one full week, a couple of hours each day, it will cost you only 7x2x4x9 = 504 seconds, less than ten minutes. This is much less than what you spend in total on brushing your teeth during a week. It is more like the time you use for tying and untying your shoelaces (especially so if you live in a country where you don't wear shoes indoors).

* * *

Chapter 25. A Dream

What would it take, for humanity, to discover a deeper underlying connection between mind and world, one that would truly unify our current understanding of science and contemplation? Two things: patience, and wisdom. Patience, because it is likely to take at least a few hundred years if history is any guide. Wisdom, enough to let our global society avoid the kind of calamity that might set us back so far that scientific and technological knowledge will be effectively lost.

And what would it take to get started on this long journey toward arguably the most important discovery that humans may be able to make? Before attempting to answer this question, let us take stock of what has already been accomplished so far.

where we are

As we have seen, science has made amazing progress in the last four centuries. After rebooting itself to some extent around the time of Galileo's investigations, it has gone through the two stages of being what I called 1/3 empirical and 2/3 empirical, ready now to become fully empirical. And in just a few centuries it has become a global treasure, the one thing that humankind can agree upon and appreciate, both for its fundamental insights and the great potential of its technological applications, for better or worse.

Contemplation got a head start on science of a few thousand years, yet has never even begun to go global. Sectarian strife among major religions, and even more so within each major religion, together with a lack of communication, has prevented contemplation to follow science's lead of joining ranks and working together.

Dialogues between science and contemplation have barely begun, partly by a lack of appreciation based on a lack of familiarity especially from the science side, and partly by the fragmentation of the knowledge base especially so from the contemplation side.

where we want to go

In order to make the first firm steps toward the still distant goal of a unified understanding of the nature of reality, we need to accomplish two things: 1) to get scientists as well as contemplatives to see their own area of research with fresh eyes, beyond the internal boundaries fragmenting the terrain they work in; and 2) to get both camps to become deeply familiar with the other side, at least deeply enough to go beyond the superficial prejudices that currently abound.

This is a tall order, and it may take a few generations. However, we have to start somewhere, and there is no better time to start than right now. For one reason, there are almost overwhelming problems as well as fantastic opportunities facing us. There is the destruction of our physical environment as well as the rapid loss of traditional cultural values, leading to a sense of being adrift in an uncertain world with demagogues beckoning from all sides. At the same time, the world has never been as connected as it is now, with information freely available for anyone, right under our finger tips, about science and contemplation.

how to get there

Given that there is a definite need for improved communication and a growing shared engagement, ideally education will need to improve on all levels to prepare new generations to reevaluate their deepest beliefs about world and mind in authentic and open ways. Let us sketch such an ideal picture in a few broad brush strokes.

At the university level, undergraduate courses will present each scientific discipline as an integral part of the whole edifice of science with an emphasis on what is common and what is special in the methodology for each discipline. Graduate courses, especially, will focus on becoming aware of the differences in outlook between different specialties and on how to bridge those differences in practice.

Ultimately, on the high school level, engaged and well informed teachers will present both science and contemplation in a broad way, emphasizing what is unique in the methodology of both in a non-sectarian and open-minded way. Initially, this may be difficult to realize, with few teachers having the required background and with the presence of special interest groups that may push for unscientific topics to sneak in, under the guise of names such as creationism and intelligent design.

The first order of business will be to create a few special places where experts from many areas in science and contemplation work together, shoulder to shoulder, under one roof. Much as workshops and conferences can be stimulating, it will be only by the daily presence of people with different mindsets, that we will learn to open our eyes fully in a sustained and sustainable way for the whole spectrum of disciplines that go into a study of mind and world.

Such special institutions can act as incubation centers, to train researchers as well as teachers and other educators in a broad sense, from journalists to policy makers. These centers can begin to provide educational material for universities and high schools, as well as other places where there is an interest in discussing issues related to science and contemplation.

a new kind of university

When I applied for college, I was disappointed that there was no department of reality studies, as I described in Chapter 4. But now, half a century later, I realize that what was missing then, and is still missing, is not the presence of an extra department that would have to try to fill in what all other departments are failing to do fully. Rather, my dream of such a department has matured into a dream of establishing a university where *each* department operates in the spirit of reality research, even while focusing on their own area of specialization.

The two options I see are either to start a new university or for an existing university to expand its role to function as new kind of university. In both cases, it would be important to represent all existing disciplines, each with their own research programs, but with a spirit of appreciation for the role that each program can play within a larger vision of deep reality research into the nature of mind and world.

In either case it might be best to start with a research institute, in or near a major university, to test the waters and develop research projects related to the integration of science and contemplation. Students nearby could attend lectures and do research as interns, and in that way valuable experience would be gathered as to how to best integrate mind-and-world perspectives into existing curricula.

a dream project

Given the totally novel character of an institute of reality research, it would be best to hand pick the initial faculty, and to give them a large degree of freedom in what research to pursue and how. The best model I know of is my current work place, the Institute for Advanced Study (IAS) in Princeton, an independent non-profit institute. It is not affiliated in any financial or organizational way with

Princeton University, although its vicinity has definitely proved beneficial for both.

If I were asked to formulate a dream project, to put into practice what I have described in this book as the most interesting research program I can think of, it would be an institute for the study of mind and world modeled loosely after IAS. Instead of locating it in the middle of New Jersey, I think the middle of Manhattan would provide for far more variety of input from the intellectual community there. In that way, it could be a worthy 21st century counterpart to IAS, with plenty of natural areas of overlap and opportunities for collaborations.

The price tag for an endowment for an institute of the same size as IAS would be higher given the real estate costs in Manhattan, somewhere in the ballpark of a billion dollars. But a modest start, with one major building, in which all researchers would be housed under one roof, could be realized with an endowment of only half a billion dollars.

supreme nonfocus

To conclude this book, I would like to share an excerpt from a letter, written by one of the greatest Tibetan Buddhist teachers from the last century, Dudjom Rinpoche. I never got a chance to meet him in person, but I have met several people who did meet him and who conveyed to me the deep impression he made on them.

I found the following letter in a biography written about him titled "Light of Fearless Indestructible Wisdom." The letter is dated 1983 and addressed to a good friend of his. It contains the following advice, below. I will refrain from commenting on the text, other than to say that I have found this one of the most inspiring set of seemingly simple instructions I have ever come across.

> “You also asked about the meaning of "supreme nonfocus" during the principal practice. Whether practicing either the creation or completion stage, if there is any focused grasping, that is incorrect. Relax your mind in an uncontrived manner, without grasping, which is known as the "supreme nonfocus." When you relax in the natural state, immediately thoughts will arise. Catch them as soon as they do and recognize them with mindfulness. Don't judge the movement as bad. Just look at this movement. The moment you look, the object and the watcher disappear without a trace, and there is great vastness. That is the nonfocus state. A great teacher said if you abide with the movement in its own place, it will be liberated in the dharmakaya. As he said, if you are at ease within that movement, not pursuing it, there is the openness of emptiness regarding what is to be relaxed and who is relaxing. That again is the dharmakaya. The essence is empty, the nature is clarity, and the expression is compassionate concern arising in every direction without obstruction. Thus the three kayas are already complete within one's own self, and each individual must discover it. This teaching is the extraordinary method of Dzogchen.

In a footnote the "great teacher" above was identified as Padmasambhava, the founder of Tibetan Buddhism.

* * *

Epilogue

In this book I have shared my life-long fascination with science and contemplation, together with some ideas of how to bridge them, in order to find some form of integration or perhaps even unification. I see this book as the first stepping stone towards building a community of open-minded individuals, committed to exploring the nature of reality guided by existing ways of knowing, but also willing to go beyond those, wherever the evidence leads them.

To this end, in the last chapter I have presented a sketch for a new Institute, based on empirical studies in science and philosophy, with the inclusion of art, design and technology, to inspire and assist explorations of awareness through science and contemplation. Ideally, its members will be deeply familiar with all these areas, at least to the point of being able to have serious conversations with experts within each one.

In time this Institute could morph into a true Center of Learning, to educate a new generation of researchers for whom the bar will be set much higher than having serious conversations between scientists and contemplatives with overlapping interests. Right now, there are precious few people with a scientific training equivalent to at least a Master's degree, and a comparable level of familiarity and insight in contemplative explorations. This needs to change in order to have a fighting chance to explore possibilities for rapprochement, let alone forms of integration. And such change will start with improved communication.

communication

What kind of communication would this new institute need, both internally and between it and the outside world? The notions of practice and personal experience, in science as well as contemplation, require a concrete approach, with a hands-on feel to it. This requires conveying a spirit of

trying out new approaches, of tinkering, of exploring. In other words it needs to convey a *vision*, way beyond any theoretical armchair kind of reasoning.

Crucially, such interdisciplinary communication must take on the form of the very highest quality scientific popularization, simply because an expert in one discipline typically needs as much hand holding in another discipline as the proverbial "intelligent lay person."

So we need expert popularizers, experts both in the quality of their own understanding, as well as in the quality of their ability to convey that understanding to others. Now we can't very well require such people to have a research science level of a Nobel prize winner in Physics and a writing style of a Nobel prize winner in Literature, so the challenge is to find a realistic optimum somewhere in between.

the grain of spacetime

Let me end this book with a concrete example, in picking one particular challenge in interdisciplinary communication, of the type that would be needed in a new institute for the study of awareness. Looking for such an example, I realized that I had never yet seen a very satisfactory way to convey the sense of smallness of the distances where science expects space and time to lose their meaning. What could be a better place for science and contemplation to meet?

So I gave myself the challenge to communicate the awe that comes with a descent into the depth of the Planck Scale, the length and time scales of where we expect space and time to break down, showing us the underlying reality of the stage on which our material world is playing out, currently a work in progress within theoretical physics.

Descriptions that I have come across mostly declare that there is a huge gap between the size of an atomic nucleus

and the size of the Planck Length, of 20 orders of magnitude, or a factor of 100,000,000,000,000,000,000. However, the size of a nucleus does not have any direct relationship with anything we can directly experience. Neither does that humongously large number connect with any ratio that we have ever experienced. So we are far removed from anything tangible, in two different ways.

It would be nice to start instead with length scales that we are familiar with through the use of our own senses, and from there on to take a small number of jumps, each of which can also be spanned by something we can directly visualize, and so connect with the world of our direct experience.

Russian cathedrals

How to get a direct visual sense of the Planck length? The largest and shortest distances for which we still can see details, are about a hundred km and a millimeter: the distance of Mount Fuji seen from Tokyo, and a size of a flee seen on your cat, if you let it free to roam outside.

It is a bit difficult to see how many flees you would need to line up, to get from where you stand on top of a high rise in Tokyo to the summit of Mount Fuji. It may work better to compare indoor distances. Let us place our flee inside a cathedral, where we can get a very direct sense of the difference in size. We can see the whole of a flee, about a millimeter in length, inside the whole of a cathedral, a hundred meters in length. So you would need to line up a hundred thousands flees, back-to-back, to make a flee line across the cathedral floor.

Now let us introduce a variant on the idea of Russian dolls. We can call it "Russian cathedrals." Inside each cathedral, we place a teeny-weeny cathedral right in the middle, the size of a flee. Shrinking ourselves down to size, we can enter that inner cathedral and place another teenier-

weenier cathedral in the middle of that one, yet another factor 100,000 smaller, and so on.

finding yourself

What happens if we keep doing this? Let us find out! Starting at the largest scale we can actually see on Earth with our own eyes, let us jump down in successive steps of a factor 100,000.

Translating the view of Mount Fuji from Tokyo to the US, we get roughly the length of Long Island. To make Long Island fit into our outer cathedral, we have to shrink the island by a factor of about a thousand, from a hundred miles down to a bit more than a hundred meters.

Doing so means that the people on Long Island will also be shrunk to a thousands of their size, from a meter scale to a millimeter scale. In other words, each person on Long Island will get shrunk down to the size of a flee.

Imagine a mock-up of Long Island, shrunk to the size of a cathedral. You will then find its eight million flee-sized inhabitants somewhere on that mock-up, milling around, all clearly visible still to the naked eye.

Here is a recipe. Go to St. Patrick's Cathedral on 5th Av. and 50th St. in Manhattan, and draw a map on its floor of Long Island, including Manhattan for good measure. You can then draw yourself, flee-size but still clearly visible, on that map!

four easy steps down to the nucleus

Having drawn yourself, flee-sized, inside St. Patrick's, you can use that drawing as the first step down in our series of "Russian dolls" as "Russian cathedrals", each one inside the other, but a hundred thousand times smaller.

Blowing up your body from flee-size to cathedral-size, you will notice that you can begin to see the individual cells that a human body is made out of: guess what, each cell is now just about the size of a flee!

Repeating the same procedure, and blowing up a single cell to the size of a cathedral, we find that atoms become visible, with each atom again the size of a flee -- you can see I put some thought in choosing the factor 100,000. (^_^)

With one more encore, the atom has taken on the size of a cathedral, and now the atomic nucleus has become visible, once more as the size of a flee.

The result is that the first four steps of placing a new inner Russian cathedral inside an outer one, has brought us from a scaled-down Long Island (inside St. Patrick's) to a human body to a human cell to an atom to an atomic nucleus, as the fourth level of inner cathedral.

four easy steps down to the Planck length

So starting with as far as the eye can see, a distant mountain, we can reach the size of an atomic nucleus in four easy steps, with the three intermediate lengths being a human body, a cell, and an atom. What will happen when we continue our descent? Let's give it a try!

We start with the atomic nucleus, now the size of a cathedral. Our current experimental knowledge does not go much deeper down than that size, only a factor of a hundred. This in itself has been the result of a huge number of accomplishments, over a period of more than a century. The three smallest structures we have detected are the top quark, the Higgs particle, and the Z boson, each a ball of a few feet across within our cathedral: anything smaller is still terra incognita.

To descend further, we can no longer rely on results from experiments, so we will need to take theory as our guide, for the time being. And what theory tells us is quite shocking: to

venture on to the Planck length, we need no less than three more intermediate cathedral steps to get there, each one a hundred thousand times smaller than the previous one. Let us call the intermediate length scales, the sizes of each next inner cathedral on our way down from the nucleus to the Planck length, X, Y, and Z; for unknown, more unknown, most unknown.

In other words, if we go treasure hunting in order to find the Planck mass inside the cathedral that stands for a nucleus, or inside the Higgs balls inside that cathedral, here is a hint. The Planck mass has the size of the mini-cathedral (P) inside the mini-cathedral (Z) inside the mini-cathedral (Y) inside the mini-cathedral (X) inside the cathedral that is the nucleus. Here is a table:

Level	Cathedral	Flee	Level
0	Long Island	human body	1
1	human body	human cell	2
2	human cell	atom	3
3	atom	nucleus	4
4	nucleus	X	5
5	X	Y	6
6	Y	Z	7
7	Z	Planck Length	8

Democritus speculated that the human body, and everything else, was made up out of atoms. His speculation went only two steps down, starting with a human body, and he missed the intermediate step, the existence of human cells. But little did he know that he still would have to go another five steps down to find the atoms of space and time . . .

space, time, and awareness

When you put this book down, or whatever device you use to read it, you are using your awareness to put it down, and gravity makes sure that it stays put. Just about each waking or dreaming moment of our lives is captured by

awareness, and governed by gravity. And we do not have the foggiest understanding of why there is gravity and why there is awareness.

Starting with gravity, the problem is that it is the only force in nature for which we currently don't have a model that involves quantum mechanics. This in turn means that our best classical model, general relativity, has to break down at the Planck length, when quantum gravity effects become strong. And given that general relativity is our best theory for spacetime, it is not surprising that most physicists are convinced that our picture of a spacetime continuum breaks down at that scale. In fact, many physicists consider space and time as emergent properties of some aspect of reality, yet unknown, that governs the world of the Planck scale.

Continuing with awareness, the problem is that we have no idea how to link a description of the processes in our brains with the conscious experience. We may well get a pretty accurate description of the information processing that corresponds to our experience, before the end of this century. But after connecting the material structure of the brain with the flow of information in the brain, there is still another step to take, from the information flow to the our awareness of that flow, as our stream of consciousness. This is also called the hard problem of consciousness, as we saw in Chapter 11.

The problem of awareness definitely straddles matter and mind, and hence the fields of interest for science and contemplation. It would not surprise me if the problem of the nature of space and time would also be shared by both. One indirect indication may be the fact that the information content of space seems to be ultimately two-dimensional, rather than three-dimensional, according to the holographic principle that has been widely studied in particle physics.

Another indication, presented in Chapter 14, is the possibility that the hard problem of consciousness may be solved through the existence of an aspect of reality that is

equally fundamental as space and time, and that could be related to awareness. Investigations into the relationships between matter, information, and awareness will definitely form an important part of the research activities in the new Institute that I sketched out in Chapter 25.

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