

# **The rocket and the rooster**

## **A play of meaning through**

### **Quantum matter and the**

#### **Biology of life**

by Philip Franses and Mike Wride

*"We should not be concerned with the meaning of life so much as what it means to lead a life of meaning."* Paraphrased – Brian Goodwin, Healing our Fragmented Culture.

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## Preface

### Invitation

This is an invitation for you as the reader to join the space of inquiry to which fifteen students have already committed. The space, through the landscape of the teaching, remains open to be travelled through many more interpretations. Please enter the space with us. For this space is full of possibilities if we truly listen to it and truly see it. It is like a lake upon which raindrops fall. Each raindrop a question bringing forth a possible answer from the watery void. We open up the transcript for you to share and contribute to the magic!

### The space

Space is not empty. We have opened up the space to be receptive to how physics and biology might come together in a more whole meaning. We allow that the parts, necessary for this unfolding, suggest themselves. The parts we speak about, whether in the Universe as a whole, in Quantum Biology or in the developing embryo, are suggested as the requirement for developing a meaning between us as participants in this learning.

So, there is a completely different educational process here. We are not beginning with parts of knowledge whose outcome is already foreseen. The parts of the teaching come up as suggested by the whole meaning that wants to be born in the active space we are creating in the process. In this way, physics and biology are not isolated mountains to climb as we pick up and carry increasingly heavy and burdensome fragments of knowledge. They are natural ways and means through which the collective goal of the class, to experience new meaning, is enabled.

And thus, for the reader, if you pick up this book with the idea of receiving chapters of knowledge you are already missing an appreciation of the method of engagement. Here, the knowledge is suggesting itself as medium for a journey whose destination is yet to fully develop and whose signature of meaning can only come at the end. The raindrop doesn't know where it will fall, in which stream it will flow. But, even then, meaning remains elusive. If learning is ongoing, then meaning must change and evolve, chameleon-like. Is it truly possible for our learning to coalesce into the crystallised appearance of knowledge? Nothing is fixed, least of all us: the teachers and the students. The learning is in the process, which is eternal. We should be careful with our knowledge, to allow it to be a pointer to a unifying meaning that shall later come to speak the understanding into place within a whole context. So, meaning emerges when understanding is cradled in the supportive palm of this context. We start with the beautiful whole, we fragment and we re-create through new synthesis in collaborative dialogue within that space.

### Finding meaning

The nature of meaning is illustrated in the card game Mike does with the students (chapter 4), from which the title of the book *The Rocket and the Rooster* takes its name. We travel from outer space to the comb of the rooster's head. Here, meaning emerges as an unfolding of the parts within the

whole, rather than a reductionist fragmentation of the parts into nothingness. Meaning is at a holistic level of whole understanding that lives a story through the detail of the parts, but is not confined to the content of the cards seen separately. This same understanding we can then bring to another set of cards of the development of the zebrafish embryo (chapter 5). We arrive at a different sense of the whole, when we do not get fixated on the detail of each stage, but see that space and time are secondary aspects of the shape and the rhythm of the orchestrating of possibilities into whole form. And thus transformation is reflected in the meaning that also evolves within and between the students, the material of the classes and the two of us as facilitators, rather than didactic teachers.

The book emphasises a different style of educational process, where the unusual combination of rocket and rooster becomes the challenge to find the route of connection between the two. The emphasis is in our imagination, to find the transformative meaning that lives the parts into a whole story and which allows the expression of the whole story in each part. Such methods apply to any learning situation.

With this change in perspective in view, we are much more free and relaxed when arriving at the difficult question of how to bridge physics and biology, than we would have been at the end of difficult graduate studies in each area. Our instrument of discernment is not the Large Hadron Collider, or a lab full of equipment, but our sensibility to the question of meaning.

### Spontaneity and causality

The book outlines the new field uniting quantum physics and biology. The book is a challenge to understandings of both physics and biology seen as separate disciplines. Physics has understood the quantum realm as applying strictly to laboratory examination of elementary particles isolated from all gross interaction with the environment. So, how can quantum effects build up in the complex excited arena of cells, far from any controlled act of measurement?

Quantum theory describes a set of phenomena, whose very characteristic is the lack of any defining story about the individual elements. There is no single description of the particle. There is only the particle as embedded within the whole story of all the particles.

The underlying reason that quantum theory gives no separate account of individual behaviour, is that it is describing a ground of elemental *spontaneity*. The individual has a probability to express a potential, but there is no prescribed definiteness in how this is to happen. The quality of *spontaneity* has the consequence that there is no order, of space and time, in which each individual event is causally embedded. Instead one has to consider the combination of all such events, as they might build together a whole picture of happening, innate to the unfolding. *Spontaneity* is the key feature that shifts the ground of the mathematical understanding, from a causal structuring of individual event within space and time, into the journeying of individual possibility holistically towards a collective accomplishment. We can consider this as a primary metaphor for the process of embryonic development as well. Each cell journeys in this way – spontaneously.

Chance (as described by Franses, 2015) is the adventure of entering a world that is not yet set. It describes that movement where belief in potential is so strong that it oversteps the certainty of individual definition. The chance of existence becomes the determiner of worth. In entering this mode of chance, one immediately opens up a whole new world of encounter. Association alone gives insight into the universal qualities, for which one's journeying into individual potential is undertaken.

It is this natural spontaneous play that makes travelling so alive and different to the causal fabric of social order. When truly travelling, it always feels one enters a different mode of engagement, where the chance of existence marries one to all types of adventure before finding the collective resolution, giving meaning to the journey undertaken.

Quantum biology is then the observation of how life is a spontaneous occurrence.

The imagination now comes in from exile, with the question to be asked: Is there not something more happening here than just the literal explanation of events as they are told through modern science? A need is expressed to revisit the basic understanding of science, the journey of the universe and the embryo, the story of the atom from another perspective that is more open to some surprise meaning that life makes. We are called to travel both physics and biology as well as the inner terrain of ourselves with an openness beyond relating a mere account of known reason that presuppose existence and life. This is the nature of the course that we embark upon.

### **Two ways of seeing**

We are used to looking at physics and biology as this very abstract collection of understandings about the world, where each discovery is locked away in its separate compartment. In bringing physics and biology together, we change our perspective to apprehend what is it about the whole of our understanding that allows us to live in the fullness of meaning. In other words, our criteria for accepting knowledge changes from the specialism seen in itself, to the quality that orders all these partial understandings into a whole twist of meaning. There is a completion in the content of the material that reaches out to understand itself as a meaning in the universe. Completion, in this case, relates to a fulfilment of the content of science in a way that metamorphoses the extreme puzzle of the Universe and our place in it into the coherence of meaning. Indeed, we might reclaim the word 'science'! The original meaning of which was to know the world through various means - not just through the 'official' scientific method:

*"Middle English (denoting knowledge): from Old French, from Latin scientia, from scire 'know'."*  
<http://www.oxforddictionaries.com/definition/english/science>

### **The theory of complexity**

On the Friday before Mike arrived, the group of students were in the MSc talking about meaning.

You cannot reduce meaning. Meaning is necessarily integral. It is that quality of identity that holds all the sub possibilities together. And you cannot explain it or reduce it.

The freedom of the micro-states yet cohere in the macro state. Whole natures (macro-state of tree, or human or even God) persist in holding the freedom of many micro-states, without itself reducing to the level of these sub-actors. At that point, it seemed really clear that meaning theoretically should exist.

A key question for biology is the existence of how such macro-identity allows single meaning to oversee the multiple activity of micro-process. Biology, in wanting to reduce life to nothing but a dust of material accident (according to Neo-Darwinism), seems to be going against the evidence of what complexity science is saying about meaning.

### Form

In the complexity module we learn about the emergence of pattern through relationship.

An example was a very simple equation involving  $x$  and  $y$ . ( $x$  is the position or distance along the horizontal  $x$  axis and  $y$  the position along the vertical  $y$ -axis.)

The equations determine how an old point  $x, y$  gives birth to a new point  $x', y'$  according to formulae that define an iteration. Carrying out this iteration many times results in a pattern being created that fills space in the regularity and symmetry of its signature repeated at many levels of scale. This is known as a fractal.

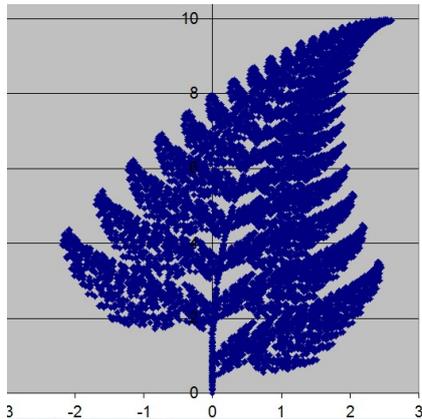


Figure 1: Fern form as generated through a simple algorithm through Excel.

Now we could see what emerges in two ways.

We could try to ask what is the mechanism that is revealed here for how ferns work? And we would not learn much from this question. We would do better however to see that it reveals that the form of fern may naturally be understood as arising out of its own ground of possibility in relationship. And so science ceases to be an explanation, but becomes, as it were, the symphony that changes seemingly random points into the movement of a form.

## The practical challenge

Meaning requires relationship. It does not require any definition of things in advance. It requires surrendering to open-ness, possibility and relationship. We must allow our egos to dissolve as we enter the room – not to suggest that we are no longer ourselves, but to inhabit a higher, more expanded state of Being at the outset.

On the Friday before Mike arrived, the group of students were in the MSc talking about meaning.

You cannot reduce meaning. Meaning is necessarily integral. It is that quality of identity that holds all the sub possibilities together. And you cannot explain it or reduce it.

The experience of the world, continuously shows us how disparate biological possibilities, concentrate into the distinction of a whole entity. Whole natures (macro-state of tree, or human or even God) persist in holding the freedom of many micro-states, without itself reducing to the level of these sub-actors. At that point, it seemed really clear that meaning theoretically should exist.

How would this work practically?

My (Philip's) first surrender was going to visit a bookshop in Exeter on the Sunday before we started teaching and finding the book "Life on the Edge, The Coming of Age of Quantum Biology" by Jim Alkalili and John Jo McFadden (Al-Khalili and McFadden, 2015). And then reading the book and having the complete shock at how far the authors go to disassociate the science they are describing from any connection to any "meaning".

The Quantum Biology book oversees the new bridge that is being uncovered, between the essence of physics, quantum theory, and the basis of biology, the molecular genetic basis of life. However the book, though broad in its universal scope, stumbles in trying to proceed by taking the specialism of quantum theory, and applying it to the understanding of biology in a rigid way. There is no leeway for an understanding that truly transforms our understanding of life.

It was a pointer that meaning had been erased from the story of biology for some other rationale than for the benefit of scientific expediency. This is discussed in chapter 1.

Heading to the train station from the bookshop, a message from Mike says that he also is passing through Exeter on the train. He is on his way to teach with me for two weeks on the MSc in Holistic Science at Schumacher College. Mike is a biologist at Trinity College Dublin, and my focus has been on taking physics outside of its specialism into the spirit of life as experienced. Together we have two weeks to probe in a slow way, how these two subjects around quantum biology, might more naturally and productively fall together. We start fittingly in the synchrony of sharing a journey from Exeter to Totnes.

## Into the void

Meeting Mike on the train, opened the question: what were we going to do, in the two weeks of teaching?

It was simple for me to say to Mike come and teach during the two weeks together. But the point was, I had my things I wanted to say and Mike had his things he wanted to say. Mike had his own being, authority, and university status. I had developed my own habits from working in the freedom of Schumacher College on the MSc in Holistic Science. How was this going to work, putting such two separate disciplines as physics and biology together, without it seeming artificial and contrived?

So, on Monday (Chapters 1 and 2) it was very much that we each stated our ground. I started with meaning and matter. Mike did the introduction, which brought us to the journey of the embryo. Everything was now at this point of balance. We had introduced a ground of matter and meaning, but it was unclear how we should enter it; how should we cross that threshold?

On Monday evening I was unsure how I was to give a talk on physics that would have any meaning whatsoever. Anything I imagined would just be oscillating between physics and biology. What would be the point of that? Who would follow it?

At some point on Tuesday morning, I made the unfamiliar step of saying to myself:

“You know what? I really have to trust Mike, and Mike has to trust me.”

The teaching would not work if we were two islands who were defending our own ground. If we stayed in our own sphere of authority, nothing would develop beyond that. Somehow, we had to trust each other for it to work. And as soon as we made that commitment, things began to get clear. For then I realised that instead of embarking on physics, as something completely separate, I could start with the embryo, as bringing in that whole understanding of physics, about light, Maxwell’s equations and the grid of that wanting to be born through itself.

When I said I am going to trust Mike, it changed the dynamic. Like the fern equation, there was this generative relationship that could develop.

Thais: laughs

Philip: Yes, seriously!

Thais: You hugged him through an equation!

## The class (the introductions from Monday afternoon)

Alex: I'm from Western Canada and for my entire adult life, I've balanced novelty and [the] perennial. This balance. I did a double major in digital media and liberal studies, which is kind of like the classics. And I've been going back and forth between these two highly mechanistic, highly superficial, in many ways, surfaces of media. And then looking at media itself as a boundary, as a media, something that mediates. And then the perennial. So, philosophy and poetry. I'm an amateur poet. And I'd like to be a polymath or a philomath, but I'm aware of the challenge that taking that on entails.

Evelyn: I come from a mainstream biology university education. And as we're talking about Newton and so on [in Philip's class earlier], so I get these flashes of a calling when I was perhaps in my teens and how I loved the uncovering and that deep curiosity about the way the world works. And that quotation "*And God said let Newton be and there was light!*". You know, I thought "*Right - that's it for me!*"! So, as a teenager, growing up at school, although there were painful moments of "This is not biology!" when you dissect and kill and dismember and yet there were ways in which [there was] this excitement of getting to the truth. You know, there was a thirst to get there. So, I went through the mainstream education. I've been a science teacher also for many years and one of the reasons I find it almost impossible to be so now is not feeling that I'm telling the truth in the classroom. Not being able to tell these stories, that there's another story, there's this deep undercurrent of other stories going on about why science has become the way it is right now. So, for me that's a painful thing about science education and where it's gone off the track.

Jörn: I am from Germany and somehow my whole life didn't fit into that mainstream story. So, early on I felt like I was kind of at the side of this main story and myth of matter. And yet when I entered university I had this freedom to explore, which as also at the edge of the normal course I was supposed to be studying. But this whole thing in deep inquiry led me to questions: what is the root cause of this crisis we are facing? What is my role in it? What does it mean to be fully human? And so I got into areas like rites of passage, ecology deep ecology and depth psychology. So I went on a vision quest to somehow uncover a deep connection that's there that I find appropriate and so out of that I want to try to embody and guide others on their journeys.

Karina: I am from Brazil. I am a journalist. I studied journalism. And like everybody here, my story is very similar. It didn't make sense for me, journalism, the way it was. It's lack of purpose. So, I decided to look for my purpose in journalism. So, during a shamanic ritual, it became very clear to me that I needed to become a voice for the Earth. So, I became an environmental journalist. And, again, through another shamanic journey, I had this very deep calling coming from the Amazon Forest. So, I moved to the Amazon Forest and started to work for it. And now I have come to a point where environmental journalism as I did it for the last ten years doesn't make sense for me any more, because I understand the importance of sharing negative stuff - what's going on and all the things that we've been doing and all the suffering, but I couldn't do this emotionally any more

because, for me, it was too hard. So, I decided to become a holistic environmental journalist. So, writing about inspirational things, good things. I can help people connect spiritually with nature. I also started one project in Brazil that is called 'The Re-connection Amazon Project' where through talks, classes and also field trips I use deep ecology, information and sensitize to bring people closer to the Amazon emotionally. This is my new task - making people fall in love with the Earth through the Amazon Forest, maybe to somehow save it from destruction.

Ole: I also grew up in Germany. I always felt very eager to learn and I loved being in school and learning exciting things through experiencing and through playing and afterwards, after finishing high school, I went to Brazil for one year working with kids in favelas doing an educational - actually circus and theatre - project. And for me, somehow it was clear, I would go for one year rather than going to university. I had so many ideas about what to study. So many directions. This idea was there of course, but I felt as well it wasn't quite my idea that I am really looking for. And I felt as the time came closer to choose what to study more and more that I'm looking for another way. So, I explored different things, I decided to head off on and go for a journey in looking for the people I wanted to learn from in life. And this in the end brought me here for the second time now. And I'm very much on my quest yet and I'm exploring the world and seeing the wonder around me. Being amazed with it. And as well I think finding my place. How I am.

Fabio: I'm from Brazil. My career was more in the world of matter. More in business and law. As much about getting things done. Not really understanding. Of taking the world as given and getting things done. Coming from Brazil, I worked in the private sector in private equity, policy, NGOs, development work. And my inquiries were mostly done in my private life with travels and reading. And after a couple of years into my career it became very clear that I couldn't keep it separate anymore. So, that's why I'm here and I have no idea what will come next.

Lea: I am from Germany as well. And I studied environmental sciences - my Bachelors. I struggled a lot with the levels of control.....within this specialization, it was quite broad. So, [there were] different approaches to this topic and I wasn't satisfied with any of them in the end. So, I chose environmental chemistry - it seemed the easiest one for me. And then afterwards I did internships and tried different projects and different ways. I went to Sweden to study human ecology, an anthropological [approach] to this topic ...which was in one way a deeper approach, a more satisfying approach, but on the other hand also very frustrating in many ways. So, I was very close to just stopping the whole thing, working in a cafe or doing any old thing. So, I'm giving it another chance in a way and trying another approach....I just couldn't find the approach that fit me, that I could feel comfortable with. It was just too heady and not deep enough. Too superficial and not seeing the real problem.

Isa: I am from Brazil: I was very curious because we have a German, a Brazilian, a German, a Brazilian! [Laughter]. So there's a pattern - couldn't avoid that. I have a scientific background because I am an industrial engineer in Brazil, then I did a MBA in business. I didn't want to go

straight into finance. I studied marketing and organizations and technology choice and I ended [up] working, in all of my working experiences, I was always taking care of people. In the way I did what I had to do in the job. I mean, tasks were done. You have to do what you have to do - we are asked to - but how can you do it in a more pleasant way, in being more supportive and even when I had a top manager place, I was creating boundaries and making the work more pleasant for who I was working with. And this gave me a lot of stress. In Brazil, you have very distant locations. So, maybe I knew a lot and I had to share a lot, so it was exhausting doing teaching, dealing with tasks as they were developing. I never worked with something pre-established. I was always creating methods to do things. That happened to me automatically - I didn't really choose it. I stopped working formally in 1988 because I moved from Brazil to Italy. And there I tried not to waste my time doing nothing. I couldn't really engage in formal work, so I tried to learn all I could to make my life better. So, time to I investigate energetic healing and art and music and whatever I could. And since 5 years ago I teach yoga. And now what I would like to have is a chance to gather everything I experienced to share and this resonates with how I think and how I see myself. I don't have a clear idea of what I'm going to do. But this is the price I consider myself in life - a privilege to study again and reconnect.

Ida: I'm from Norway. My background is archaeology, art and environmental studies. But I grew up in the forest and my primary society or community was the forest and nature.

Brenda: I have been very interested in symmetry and possibilities and contrasts, so I think that is reflected in many places - like I was born and grew up in Mexico and at the same time I have strong links with the United States, Italy and Switzerland. I studied business and marketing - that combination of the precise and the creative. And I worked in that field for many years trying to bring more possibilities like the beautification or ethical projects and then I discovered that the field was really exhausted of different possibilities and it was all about profit. So, I have been searching this shift for a while and my key purpose is bringing that spiritual practice or spiritual path and merging it with my overall life, instead of having a parallel of work and social and then spiritual, but merging it.

Diana: I guess I can say that I research connections between body and emotions and between people through emotions and through story telling because I'm an actress mainly, but I worked with co-creation through theatre. So, I've changed points of view many times. So, I was an actress, a director, a coach and a producer, so I did the same thing for many years with different points of view and perspectives and different experience. And my background, my degrees are in dance, drama school, social communication and bioenergetic therapy. And I really like how theatrical games can be connected with curiosity.

Thais: You'd think this would get easier over time. I'm also Brazilian. I was going to do a double major in biology and psychology but then I had to start university again. I was living outside then I went back to Brazil. I concluded my psychology major, but biology was always something I was very linked to and found it very easy. It was always very natural to me. And going back to Brazil was a deep way of connecting and I have a deep sense of social responsibility within that. I was working with

sustainability inside a national company doing climate change work and working with community development and projects like that. So, I did see bridges between the subjects: psychology and biology. Not always easy to explain to people. But then I had enough of that. I do think I learnt a lot, but companies do suck the life out of you. There are better ways to engage and put so much energy because we have a lot of work to do. So, I'm here to find new paths and to put my energy to better use.

Brian: I'm not Brazilian [laughter]. I'm Canadian, a neighbour of Alex's by Canadian standards. [I'm from] B.C. I'm sort of a generalist I guess. I kind of escaped a lot of work life and career and all that. I chose living. Lots of travelling. Lots of school. I went through a lot of science and economics and settled on social sciences: anthropology and human geography and right when I was about to graduate, I decided to double major in environmental studies. So, I've always had...I grew up in pretty wide open spaces, so I have a strong connection to outside, I've always worked outside, spent lots of time outside and I want to continue that. I've always had a strong connection to place by region, a place-type localized context, but I'm pretty interested in everything.

Elisa: My background is in economics as an attempt to understand the world a little bit better. But, the obvious paths after that, I could not follow the obvious paths after that. I was looking for something else - meaning and action together. I think that's how I ended up here.

Titiana: Being here, I feel like I'm uncovering that fact that I grew up in a world that's attached to matter and really shying away from meaning. And that it was always a very urban world, a world of non-responsibility and innovation and policy taking over self-responsibility. So, I feel like I'm here to find this gesture between meaning and matter and put it in practice.

Sindhu: I studied biology in University, but after that I wore many hats and tried many different things, travelled to do different things. Very recently, I worked with children in a school before coming here. In the school, we didn't refer to ourselves as teachers. So, it's hard to say I was in a traditional teaching position. It was more like this, but with lots of children. I'm exploring this idea of what is really holistic thinking or science when it's for children. How can we relate it on that level? Of course, children are naturally holistic in one way. They have that innate freeness. I want to explore that.

# **Day 1: Monday**

## Chapter 1

### Just matter

*This transcript refers to a talk beginning the second week of the Chaos and Complexity module in Holistic Science. What happens when we bring matter and meaning together in a living story?*

*Scene: The Msc room at Schumacher college is a small room fitted under the beams of the sloping roof that for almost twenty years has been the home of the inquiry into Holistic Science. Every year 15 or 16 students take their place, for no more fit in this space to take up the inquiry. But through these transcripts, it is as if one more place has opened up for you the reader, to fit in.*

*Time seems to slow down, into a process that has taken on the rhythm of years of study, and space seems to empty out, receptive to new ideas.*

A minute's silence

### Possibility and certainty

Philip: So, I want to introduce where we are going by telling you about my day yesterday. So, when I woke up yesterday, I was thinking about this thing of meaning and matter, which is where we were on Friday.

Thais: I normally just think what I am having for breakfast!

[laughter]

Philip: That is the advantage of being a student. When I came here [as a student to Schumacher College in 2005-2006 to study Holistic Science with Brian Goodwin and Stephan Harding], I couldn't believe it, because I was a computer programmer before I came to study at the college to do the MSc. And I couldn't believe the life of a student, where you just sit and wait for people to come and tell you their ideas, have great food and talk to people. Whereas, before I had been computer programming, and you had to say what you were doing, which client you were working for, between 12.00 and 12.30. So I think being a student is really terrific.

Good that Mike is here now. Half the time I will be a student. My introduction of Mike to you is in the telling of this story.

It was the same when I was writing my book, that when I got stuck, when there was something I couldn't quite get, there was one thing to do, which was to go to a bookshop. This meant going to Exeter, the nearest big bookshop. The reason I was stuck was that... (writes on white board)

Last week we had been looking at mathematics and we had shown that there was a path from mathematics to non-equilibrium systems, that led to 'nothing transforms into form' that led to micro-states aligned to a macro-state.

We gave many examples of this, including ourselves, that you cannot disassociate from meaning. You cannot reduce how we have millions of micro-state activities that are all committed to one macro-state of who we are. That whole thing is the act of meaning that you cannot reduce further.

Does everyone agree with that?

Isa: Too early to decide

[laughter]

Isa: The micro-states are related to the meaning they bring to the whole.

### **The irreducible identity of meaning**

There are millions of possibilities in us as human beings, in our bodies, millions of activities, and yet somehow all those activities cohere in their possibility and they make a human being. They make one identity. This is the basis of complexity. It does not make sense to try to reduce this. It is not to do with what we are made of - cells or atoms or genes or proteins. The fact is that this meaning exists. We can talk of this meaning in an entropic way. All those possibilities together are low-order, yet they all cohere in us in a higher order. So we could even talk about that mathematically. You cannot get away from that miracle of that identity in which all the partial states cohere. This is the very ground, on which complexity is standing.

Thais: When you say “nothing transforms into form.....”

Philip: You don't define anything in the beginning. It is not like when you are building a house - that you start with this brick and that brick and that brick.

Thais: All the parts.

Philip: Here, nothing is stable, everything is in that whirlpool of activity and somewhere in that whirlpool, this whole being appears. This is the side of meaning. Now we come to matter.

Classical science deals with equilibrium systems. You have stable building blocks. The laws of science are built upon the second law of thermodynamics, which says order always decreases. Everything began with the Big Bang, order was there and gradually decreases. And the result is a world built of matter. This relates predominantly to systems in equilibrium, where it is possible, in contrary to the above situation, to isolate and define each of the parts.

Matter is on the side of things. Matter is found when we are able to isolate something from all responsive influence of the environment and we are able say this is an atom. And it is an atom today, tomorrow, ten million years time, in you, in me, in Costa Rica. It is completely context independent. We can find these things that aren't in the flow of relationship at all, and once we have found them we can say this is how the universe was built. For there are these things, these tiny little things and when we add them together, we get structure, we get cells, we get organs, we get humans, plants.

There are these two possibilities within the mathematics.

And the reason I startled awake with a worried feeling of “How am I going to teach tomorrow?”, is the following question. How is it that given these two possibilities, that physics is so exclusively focussed on matter, unreasonably focussed just on matter? And not only physics, but we find the same when looking at biology, which is why Mike is here, telling the other half of this story. I am telling you the physics side and Mike the biology side. First, physics concentrates just on matter. And then biology, which should be about meaning, after all, because it is about life and life is all about this quality of existence, that all these relationship can cohere in a single identity. But, via chemistry, biology also says it should be dealing with matter only, for it is taking its lead via chemistry from physics. Biology is only allowed to talk about matter. And that is even more perplexing, how are we going to go into this week and talk about biology, if we cannot talk about this basic mathematics of meaning or form, that all these different potentials in relationship add up to a meaning?

A big Sherlock Holmes mystery. I really like a mystery where you suddenly think “Why did that happen”? So, I got on the train to Exeter.

### **Quantum biology – a first acquaintance**

Philip: I got on the train to Exeter and, as usually happens in these cases, I knew I needed to find some book, which would help clarify the week. If it is so obvious that meaning is as relevant to mathematics as matter, then surely it is obvious that to talk about biology, we need to start with meaning. How do forms like ourselves exist, with all these millions of possibilities interacting in a coherent state, a huge disequilibrium? It is not that our genes simply build the human being. We have quite clearly established that through our science. We have even listed all the genes and know that isn't the case.

I walked into the bookshop, and the first book I saw on the bench of new books was “Life on the Edge, The Coming of Age of Quantum Biology” by Jim Alkalili and John Jo McFadden. Funnily enough I was looking for another book by Jim Alkalili on quantum theory, for I know he is a good writer, so when I saw this Quantum Biology, terrific!

The book is talking about physics and biology, the ground Mike and I want to cover this week, so what better book to help uncover the source of this irrational unease about matter and meaning? Why has meaning being pushed to the side, and why is matter so prevalent? And when I started reading the book, it seemed to fulfil my quest. It talked about phenomena, incredible phenomena such as birds migrating and how is it that the birds are able to pick up these incredibly small variations in the magnetic field? He talks of robins going from Sweden to North Africa in the winter, to navigate back to the same place the next year. He is talking about how do the birds make meaning. So you think: “This is the book I was looking for; he is going to talk about how biology and meaning are really one”.

## The fall of matter

But that is not how the book proceeds at all. [laughter] It is like reading a guy who has a nervous tic. You are reading a paragraph about this robin and suddenly, from out of the blue, he will say that in the 1920's they used to believe in the soul, but it is clear that in modern science we do not need the soul. The book continually makes clear that quantum biology is completely materialistic.

If he introduces an idea of physics, it is always in terms of what it can do for humanity. It is not talking about the wonder of the world, but in the cleverness of the human, who, in doing science, is controlling the world, and manipulating existence. You cannot believe it, for it has nothing to do with the poor robin. The robin is doing this amazing thing, but the author continually has to take a dig at the soul, and says he is a real scientist because he doesn't believe in the soul.

“Even in this age of genetic engineering and synthetic biology, nothing living has ever been made by humans entirely from non-living materials. That our technology has so far failed to manage a transformation that is effortlessly executed by even the simplest microbe on our planet, suggests that our knowledge of what it takes to make life is incomplete. Have we overlooked some vital spark that animates the living that is absent from the non-living?”

But, this is a completely self-defeating dig at meaning. You cannot dissect meaning. You cannot say that we have not yet found on the side of matter, what this thing called meaning is. For meaning is by its own nature, holistic. The wholeness exists on the other side of the possibility. It doesn't exist as some *thing* that you can march up to with your knowledge, and your synthetic biology and fix. The authors continually reinforce that to be a real scientist one has to rid oneself of the superstition of a soul.

“The concept of a soul, while no longer part of modern science, did at least separate the study of the non-living from that of the living, allowing the scientist to investigate the causes of motion in inanimate objects, unencumbered by questions of philosophy and theology that bedevilled any study of living creatures.”

So, the book continually refers to the soul as this encumbrance that superstitious man had, and continually reiterates that modern science does not entertain the soul. This whole understanding of entropy about irreducible meaning has for no apparent reason been ruled out of science.

This made me even more uncomfortable.

It is not that there is a rational gain, by putting to one side what is difficult, while we concentrate on what we do understand, to come back later to the larger picture. This is as a guy with a tic who at every opportunity has a dig at the soul, as something of which the content is not concerned. It is more like a taboo. The true scientist must demonstrate his freedom from meaning or soul. Digs about the soul, come in the middle of chapters, without benefiting anyone. The book is not about theology or philosophy of science, it is about the navigational skills of the robin. Surely the question of meaning should be something that science should allow to emerge through the facts? The book is

presenting the facts so people can make their judgement, yet still, for the book to be taken seriously, it has to first demolish the idea that it has anything at all to do with meaning. This is even though most of mathematics and its relation to science is about meaning, is about something holistic.

[At this point the book, which had been propped up on the table before me falls seemingly by its own action off the desk causing much hilarity in the class.]

Now we have got rid of that! Now, having dispatched that, we can now look at: what would a science that includes meaning look like? Could there be a science that embraces the scientific reality of meaning, and yet incorporate some of the advances of physics and biology? Can we have a biology that is in the dynamic relation of whole and part, is in the dynamic relation of meaning and matter? It is like the dance we did, we can have the dance of matter and the dance of creation but the real dance is when we bring the two together.

*[This comment refers to a game in the first week that began with a mechanistic movement, and then a creative dance, and then found a dynamic way of joining the two together].*

But now I was even more disturbed than when I set out. For it wasn't even that there was some rationale behind this dig at soul and meaning.

### **The world of meaning**

So, I want now to make another slight digression, if that is OK, into the world of meaning, when it still existed. So we run a series of events called Process and Pilgrimage. This started in England in 2009 and then it went to Italy, 2010-2012. In 2014 we went beyond Italy and had an event in Cordoba. {[www.journeyschool.org](http://www.journeyschool.org)} And Cordoba in the 10<sup>th</sup>-13<sup>th</sup> century was a place where Jews, Arabs and Christians lived together in complete harmony and there was a fantastic outburst of creativity from all these disciplines of science, philosophy and poetic expression at the same time.

What sparked this was the enlightened leadership of Andalusia by Caliph Al Hakam II, a descendant of Mohammed, who by some chance became ruler of Southern Spain. He was a Sufi. Part of the approach of Sufism was that one should address the name of God without any mediation. One should address God directly, without priests or laws in between. It should be everybody's right to unmediated address of the name of God. This understanding meant that it didn't matter if you were Jewish, Islam or Christian, you had the same right to address God. It didn't matter if you did this through mathematics, or philosophy, or prayer, or poetry. These were all valid ways to make that approach. There was this flowering of beautiful sacred geometry patterns, buildings, mosques, libraries, philosophy, mathematics. Some examples of people living in and around Cordoba in the 11<sup>th</sup> and 12<sup>th</sup> century, were:

- Moses Maimonides, Jewish, who wrote in Arabic, A Guide to the Perplexed. This was a totally revolutionary view of Judaism, as something more than just a collection of traditions and rituals, but answering an existential question.

- Averroes, who translated all the Greek texts of Aristotle and Plato into Arabic. He said alongside the direct appeal to God through prayer, equally valid was the approach to God through philosophy, of Aristotle and Plato. And this was accepted, that you could have an intellectual approach to meaning alongside a theistic one. And so Averroes was a huge bridge, because before that Aristotle's work was not really known in Europe. He provided this bridge, at which all that knowledge and understanding came back into Europe.
- Ibn Arabi, who talked about the one and the many, multiplicity in unity, was completely on the track of phenomenology, that continental philosophy explored in the 20<sup>th</sup> century, but relating this to Islam and to God.

All these people were involved in the address of meaning, through science, through literature, through poetry.

### **The overthrow of meaning**

Not everyone was happy with this state of affairs, especially some elements within the Church. Before, Southern Spain had been Christian, so there was a faction within the Church very keen to win back these territories from the Islamists. Gradually the Andalusian Kingdom began to fall apart as they lost one place after another to the Christian group, wanting to establish a central authority. The final place to fall was Granada, the home of the Alhambra, an incredible collection of palaces, built by the Muslim people of that period. The Christian hierarchy at that time needed a philosophy to win back the people from the Muslim ideology.

The card up their sleeve was that in Islam everyone had direct access to God. There was no need for access to God to be mediated. But the reactionary group could argue that in Christianity the access to God was through the single channel of Christ. Access was through the Son of God, it was somebody special. So there was a preordained story about what was true. In Christianity, there is only one revealed conduit of that relation to God, so there is only one real story. And only those who are bestowed with authority are allowed to talk about God. So this became a good juxtaposed story to put alongside the Muslim story, where everyone had access to God.

In 1492, the Christian faction took over Granada, and said to Queen Isabella, "we will honour the Arabs if you give us over Granada." And very soon after, it was clear they weren't going to honour the Arabs. For once they were in power, they set up the Spanish Inquisition. The alternatives given to people were to accept the pre-ordained Christian story and convert, or to leave the country, or be killed. If you were Jewish or Muslim you had to either convert or leave. The pre-ordained story was now the one game in town and the priests had the exclusive authority to tell this story. So, you better honour it and forget about everyone being free to tell their own message.

### **Shift**

The Islamic world of the 10<sup>th</sup>-13<sup>th</sup> century in Spain was as a complex organism, where all the different possibilities could exist, and God was the Unity that brought all these possibilities together. So, the Kingdom was going to be magnificent and wondrous, not because anyone was controlling it, but because everybody in the end was going to agree on this quality of what brought them all

together, it doesn't matter if they are philosophers, mathematicians, builders, lawyers, architects, Jewish, Christian, Muslim.

So, suddenly there was this shift.

Thousands of Jews, including my ancestors left to places like Greece, where they were all allowed to settle. And until recently the law was still active that you could not practise Judaism in Spain.

This other story was born, that was opposite to the Islamic story. There was this pre-ordained story, that had been given to Christ and only those with authority bestowed on them were allowed to tell it. And everybody else had to do what they were told. This might start getting familiar.

What happened then was, at first, this bullying won the day, and there was a certain benefit in having one story that united everyone together. The Renaissance was bringing everything together into one story, in contrast to Andalusia where everything was allowed to flourish as many different stories relating together into a meaning.

Isa: There is a very nice book about the Sefarad, Ornament of the World.

Philip: Yes, a very good book, I have read it. It is a beautiful book, telling the whole story of that era.

Isa: And it says the Arab language brought this colour and the ability to express feelings that the Latin was lacking. Latin was business language and Hebrew was a business language. What I want to bring out, is the importance of having the words to describe something when we do not know how. So, for instance, in Holistic Science instead of talking in esoteric language, we can use the description of whole and part.

Philip: Even the word meaning has become so overused. We are talking about something we can describe very simply. It is irreducible. It is present in all organisms. It is completely acceptable from its scientific perspective. It is not something that science has got rid of four hundred years ago, or when you give a kick at soul you have kicked out this meaning with it. For meaning is completely implicit within science and mathematics and complexity.

Alex: Was it [Henri] Bortoft who used [the word] 'mean' as a verb [as in] 'it means'. 'It arrives at coherence'. Meaning is the apprehension, the meeting of coherence.

Philip: Language is always important. It is the verb nature of meaning. It is something that happens. It is not a thing. You cannot reduce that happening to things. That is something completely missing from the Life on the Edge book, where all description is in terms of nameable things. What things are there influencing the world of the robin? Half of science is about process.

Alex: This fits into quantum measurement. How as soon as you try to measure something the whole becomes a part, particular. You do not meet the thing.

Philip: Whole and part are always both there in the phenomena. If it is a stable place you can isolate these bits of matter. If it is a vortex of possibility, then there is meaning. But you cannot separate one from the other.

Shall we go on with the story? I am glad someone has given us an apple [a large cooking apple is on the folding table]. I don't know where that came from. Does everyone know the story of Newton and the apple? He was wondering why the world was the way it was and an apple hit him on the head and he said "Gravity".

### **The new priesthood**

Newton had a great overlap with Leibniz. Incredible, they lived at the same time. Newton was born in England in 1642, Leibniz in Germany in 1645. Both Leibniz and Newton embraced the world with their thinking, their imagination and their attempt to find a new understanding based on mathematics.

Leibniz, if he had been alive today, would probably have been sitting here (a Holistic Scientist before his time).

Leibniz was a prodigy who could have had a professorship but he said he didn't want a professorship. He didn't want that artificial world of the university. He wanted to learn from life. Throughout his life he had jobs like being librarian to some German Duke or administrator. He was also a mathematician. He co-invented calculus, the mathematics of change. He used calculus in a completely holistic way. Leibniz was a mathematician, and uses mathematics to go down the path of meaning.

Leibniz went into the world, you could imagine him wandering around the streets, wondering, coming to an idea, and finding a bench to write it down on. Leibniz was about understanding the relation to God.

Most of Newton's writings are on alchemy. But unlike Leibniz, Newton was a professor at Cambridge. To begin with, he was very reclusive, and hated being criticised. So, when one of his early papers was criticised by Hooke, Newton stopped publishing anything for a long time. One of the things he discovered that he did not at first publish was calculus in 1665-7 when he was living in isolation at his country house to get away from the Great Plague.

Around that time was the thirty years between Protestantism and Catholicism. There was this war of attrition, with this new version of Christianity, with Luther.

In 1517, Martin Luther had initiated Protestantism, as a direct challenge to Catholicism as the only interpretation of Christianity. This might not have been a problem in normal times. Often it is good to have a different story as it helps to see the truth of what you are trying to say. There was one snag to this. Christendom had put all its eggs in the basket of this pre-ordained story, by which it had authority over the people. But now another story had been told about Christianity. And this story soon splintered into many different sects. This completely ruined the whole game. If you have this

pre-ordained story and you have the authority to say who are those able to tell the story and then another story comes to be believed other than your own, then this is an existential calamity.

The Thirty Years War (1618-1648) was in many respects a fight over who was to be the dominant group. And was it to be a religious or a political story? Lay groups, as the Anabaptists, suggested doing away with the priesthood altogether. This was one of the few things over which other groups united in their opposition. The northern countries, who had adopted Protestantism and the Southern countries who had remained with Catholicism fought this war that went on and on and on, it was completely exhausting and destructive.

At this time that Leibniz and Newton came along, there was this real unrest and troubled feeling of exhaustion. They were looking for something new. The pre-ordained story was not working; it had fallen apart, as there were now many rival pre-ordained stories. In 1686 Newton came along with his *Principia Mathematica* that is full of diagrams, explanations and theories about matter. Its subtitle is "*The motion of Bodies*". Many aspects of matter were mathematically explicated and ordered. Newton explained in really simple terms how matter moves, what are its basic laws. It was a great work. This book was the first work of mathematics that gave real insight into how the everyday world works, allowing us to understand the world in a way we hadn't before. But even more amazing was how it was received.

The book was received with a tumultuous acclaim. For instance, Halley's preface poem Ode to Newton began:

To the illustrious man Isaac Newton and this his work done in the fields of mathematics and physics a single distinction of our time and race.

Matters that vexed the minds of ancient seers,  
And to our learned doctors often led  
To loud and vain contention, now are seen  
In reason's light, the clouds of ignorance,  
Dispelled at last by science.

And ended:

Then ye who now on heavenly nectar fare,  
Come celebrate with me in song the name  
Of Newton, to the Muses dear; for he  
Unlocked the hidden treasures of Truth:  
So richly through his mind had Phoebus cast  
The radiance of his own divinity.  
Nearer the Gods no mortal may approach.' (*Halley in Newton, p.x111-x1v*)

It is absolutely incredible how Newton went from being this shy mathematician working on these equations for year after year in complete solitude, to this complete superstar overnight. He was made president of the Royal Society, the most prestigious position within science. His mathematical work was taken up within a quite different narrative.

With the Thirty Years War had come the realisation that there could not be this one story of Christ, this select person revealing of the law of God. This whole way of Christianity ruling Europe in the wake of the Arab rulers who they had overthrown was at risk. And suddenly here was the answer. In Newton was found the seed of a new story. Instead of the one story being about Christ and the revelation of God, the one pre-ordained story that only those with pre-ordained authority could tell, suddenly the story became matter and physics. The good thing about matter and physics was that you didn't have to worry about different interpretations. For a start, very few people understood it, so it was easier to say this as the one story. Newton was bestowed with the authority of the new priesthood.

Karina: What is the Royal Society?

Philip: The Royal Society was set up in 1660 in London as a college of natural philosophers and physicians. They published Newton's *Principia Mathematica* in 1686. It brought together all the scientists. So Leibniz, when he went to London, visited the Royal Society and was also a member.

Christ had said "No man can serve two masters: for either he will hate the one, and love the other; or else he will hold to the one, and despise the other. Ye cannot serve God and mammon." (Mathew 6: 24, King James Bible) There was another exclusive story to be told that did not risk itself on the interpretation of God, and that was matter. So, for Christendom, this was a fantastic answer, stop telling the story of God and start telling the story of matter. For when telling the story of matter, you were no longer susceptible to the Protestants coming up with another story than the one you were telling about God. It started off saying there was a pre-ordained story about one meaning. There was now a pre-ordained story that had no meaning, which was much simpler. Nobody could argue about it. Overnight, Newton became the new priest and like a priest it was his job to set up a bestowed authority, a priesthood within science of people who could be trusted to speak the truth. It looks like Newton's personality completely changed, when he was lauded for his *Principia Mathematica*, from being inward and introspective to being outward and domineering.

Even today there is a vestige of this, obtaining a PhD is as becoming a priest. Authority is bestowed on you to talk about the knowledge of matter, the pre-ordained story. But otherwise your opinion is not required.

When I tried to do a PhD, it was like doing an apprenticeship. I was advised to argue something of which I was not really interested in. Do not say anything I wanted to get really involved with. It was like becoming a priest. Authority is bestowed on you to talk about the language of matter, and the one pre-ordained story is matter. But if you are a Holistic Science teacher, you might as well keep quiet. You do not have the authority to speak, you have not been given a bestowed authority.

It seems to me that it suited both the Church and Science. The Church was riven by this Protestant-Catholic rift and could no longer maintain this one story. And they could not stamp out Protestantism.

This: And they wanted to keep their power

Philip: And it allowed them to keep their power by telling this pre-ordained story. But, instead of this one pre-ordained story of meaning, it had turned into this pre-ordained story of no-meaning, the science of matter. There is one story that is science, which no one understands except the elite with bestowed authority and that story is about matter, where meaning plays no part.

Evelyn: This is why I have become more and more drawn to Goethean science because it allows us each to tell the story, you do not have to go through the high priests.

Mike: The paradox is that Newton's alchemy was the way towards self-knowledge, that was surely the whole point of alchemy. So did Newton suppress his own interest in alchemy, becoming one of the priests?

Philip: Yes, it seems to me that Newton's personality completely changed. When he was lauded with the fantastic preface to his book, he was suddenly beyond vulnerability. His personality changed from being inward and introspective to outward and dominating. And the next thing we will see is what happened with Leibniz.

### Expulsion

There was one cloud on the horizon. Here was this incomprehensible mathematics that was the new pre-ordained story. Everyone was happy with it. The powerful had a new authority to bestow. Newton was riding the waves. He had accepted the priesthood and was leading the new material age, even though as Mike said it went against his alchemical research. But there was this one cloud on the horizon, which was Leibniz. Leibniz was actually saying that mathematics was to do with meaning. We had this whole story set up, we have invented the calculus, there is new mathematics. But oh no. There is this Holistic Science guy wandering around talking about meaning. What are we going to do about it?

Leibniz and Newton had both discovered calculus in separate periods.

Newton wrote up his findings but did not publish the papers he wrote on calculus, for fear of being criticised. Collins the publisher got to know of Leibniz's later discovery of calculus (1674-75) and tried to bring Newton and Leibniz in contact.

But Leibniz in 1684 published his version of calculus in *Acta Eruditorum*, without mentioning Newton at all. This at first seemed not to matter, in that they had different styles and were trying to do different things with the calculus. What would have been really good if they had come together. But, an enormous amount had been invested in Newton, as we have said, as the herald of this new age of

matter. And gradually, the dispute gained momentum, as two competing camps of supporters began to fight between each other.

In 1713 the Royal Society had a commission who was the first inventor of the calculus and gave judgement

"... For which reasons we reckon Mr. Newton the first inventor and are of the opinion that Mr. Keill [a supporter of Newton] in asserting the same has been in no way injurious to Mr. Leibniz ..."

But, the truth is they did not want Leibniz anywhere near the story of matter. In 1714 a report was published by the Royal Society headed "Concerning the dispute between Mr. Leibniz and Dr. Keill, about the Right to the Invention of the Method of Fluxions, by some called the Differential Method", which was on the dispute about who had first invented calculus. And it is obvious that Newton wrote the report, because only he had the mathematical ability. And the report has 35 pages increasingly losing the neutral aspect of somebody writing a report. On page 22 it says:

'And where it has been represented that the use of the letter o [Newton's terminology] is vulgar, and destroys the advantages of the differential method [referring to Leibniz's terminology used today]; on the contrary the method of fluxions, as used by Mr. Newton, has all the advantages of the differential and some others.' (*Newton 1714, p.139*)

Newton is trying to push Leibniz out of the door of science once and for all.

On the 33<sup>rd</sup> page, the report makes judgement that Leibniz is expelled from the Royal Society.

'I take the liberty to acquaint him [Leibniz], that by taxing the Royal Society with injustice in giving sentence against him, he has transgressed one of their statutes, which makes it expulsion to defame them.' (*Newton 1714, p.150*)

Leibniz is going against this one story of science. He is being excommunicated from the new priesthood. The report then touches on the real crux of what the dispute is about.

'It must be allowed that these two gentlemen differ very much in philosophy. The one [Newton] proceeds on the evidence arising from experiment and phenomena and stops where evidence is wanting; the other [Leibniz] is taken up with hypotheses and propounds them, not to be examined by experiments, but to be believed without examination....The one [Newton] teaches that philosophers are to argue from phenomena and experiments to the causes thereof, and thence to causes of those causes, and so on till we come to the first cause; the other [Leibniz] that all actions of the first cause are miracles, and all these laws impressed on nature by the will of God, are perpetual miracles and occult qualities, and therefore not to be considered in philosophy.' (*Newton 1714, p.152,3*)

Nailed it. You have got Leibniz out of the door. The monad of Leibniz that realises itself by bringing together all the possibilities that cannot be reduced is written out of science. What Leibniz is saying about the whole quality that is greater than the parts is discarded. Newton's first action as the high priest of the no-meaning of matter, is to push Leibniz out of this pre-ordained story. Leibniz died anonymously in 1716. Newton was buried in a state funeral in Westminster Abbey, a complete hero of the age.

But again and again Leibniz name crops up in science, proved where he was right and Newton wrong. He foresaw complexity and the relativity of space and time, where there were no absolutes as Newton was saying. The world was not a story that was already told, it was a story discovered in the telling, the way meaning holds together many possibilities. So again and again modern scientists refer back to Leibniz saying his intuition was spot on.

### Full circle

And so here we come full circle, like any great holistic argument. We have uncovered this complete roundabout way, through Andalusia and the Sufis, to a pre-ordained story about matter. Its origin was a pre-ordained story about God that overthrew the Sufis. The pre-ordained story about meaning and the relation to God then became a pre-ordained story of matter and no-meaning. Newton became the first priest of this new story. With the result that today in order to write anything about physics and biology, we have to first show our credentials as a bestowed authority in this world of matter, by dismissing soul and meaning.

To finish my day at Exeter. Mike rang up to saying his train was going to be passing through Exeter on his way to Totnes. So we went to the station and got on the same train as Mike. I showed him the book. And after the break we are going to look at the other side of this story, which is the biology. Our goal for this week and next week is how do we create a story for biology and physics that is both credible and true, but also breaks with the authority of materialism that is running science?

Brian: Well done Philip

Philip: I'll put my book here instead. [replaces the quantum biology book with Time Light and the Dice of Creation].

## Chapter 2

### The Journey of the Zygote

#### Introductions: Moving into Meaning

*A minute's silence.*

Philip: So, it's a great pleasure to introduce Mike. So, Mike has been working in Dublin for many years. He's now Assistant Professor and he's been working in biology, especially on the lens. And he sort of became frustrated about this same kind of hiding of meaning behind matter in biology, so he came to the College, like people do, on a Rupert Sheldrake course almost two years ago, which is where I met him. Then, in the meantime, we worked on the paper together, Goethean Pedagogy, looking at Schumacher education from both sides of those two worlds. And Mike has now got a new job, which is about how do we change education within the University of Dublin? Which is just a perfect kind of move and a perfect kind of alignment with what's happening at the College. So, it's like these two worlds...at the College how do we change from our side? So Mike is going to give us the other side of the story from the perspective of biology and the perspective of the mainstream.

Mike: Thank you Philip. Perhaps the way we can think about it is this class is an organism. So we can all imagine ourselves as an organism. And each of us brings particular experience, skills, expertise....Philip's just noticed something... [the quote from his book written on the flip chart].

*"Wholeness, it is said, contains everything about itself, within itself."* Franses (2015) p 7.

Philip: Yes! Somebody wrote it up.

Mike: I'm a developmental biologist or I have been. My training has been in that line. And so there is a constant thinking about movement and change and inter-relationships and very much the day-to-day immersion in issues and problems to do with the relationships between wholes and parts. And so relating that to each of you kind of telling me a little bit about your story and where you're from, and what your motivations are and things like that. There is also again the idea that the whole class is an organism and that through the two weeks we will develop in certain ways. I would like to see myself as part of the organism. I'm not like some brain cell up there somewhere that is sending signals down to dump knowledge. So it should be very interactive and enjoyable and hopefully I will learn lots and you will learn lots. And hopefully we will be a better organism as a class by the end of the [two weeks]. Notice - not a machine! [laughter].

Alex: A becoming!

Mike: Exactly!

### **Matter Exploring Meaning**

Mike: Very good. Thank you everybody. Philip's given me a nice introduction, so I'm not going to say a huge amount, other than, yes, I'm basically a (w)holist too. I grew up in the country, so I was immersed in nature when I grew up. And then I suppose going off to do my degree - physiology and biochemistry - and then my postgrad in developmental biology. In some respects I did that because I'm interested, as I said, in development and evolution and visions or a vision of a better world I suppose. And to understand the dynamics of an embryo, to me, can help you understand the dynamics of life.

And so one thing that comes to mind is.....here's a question.....perhaps life is the means by which matter explores meaning [and matter is the means by which life explores meaning]. How does that sound? Maybe that's something that we can reflect on and think about. Any thoughts on that? It just struck me. I think when you were speaking [Sindhu].

### **Mechanism and Organism**

What relates to that, from my perspective, as somebody who studies developmental biology, is that there is a certain disillusionment with the way things are in the world. And it could be argued that [this is related to], the idea of mechanism, which comes from Newton. The idea that the world is mechanistic and the way society is is very mechanistic.

Well, as a developmental biologist, I've always been thinking about systems as organisms. So, in an organism, particularly in an embryo, which is undergoing change and development, there is an intrinsic organisation - that's the definition of organism in a way is this organization, which is intrinsic. There is an intrinsic principle, which yearns towards expression, which is not present in a machine.

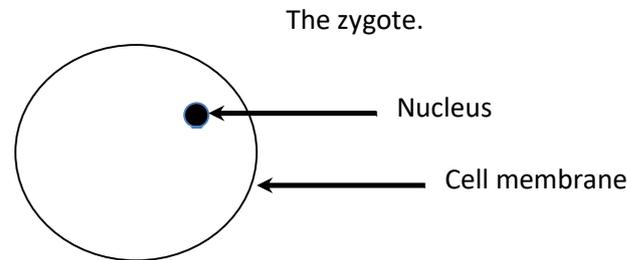
So, I think, perhaps from what Philip was saying, that when Newton became the high priest of mechanism essentially - his was the first foray mathematically into mechanism I suppose. And, as Philip says, all of our mechanized society ultimately comes from those inter-relationships between disconnected external entities that you can assemble together to make a machine. But, that is not what an organism is. So, this is why I put up the little quote from Philip's book as well:

*"Wholeness, it is said, contains everything about itself, within itself."* Franses (2015) p 7.

### **The Zygote Emerges**

So, Philip and I have had an interesting dialogue over the last little while about the relationship between wholes and parts and particularly with regard to embryonic development. You obviously have a period of development before there are sperm and egg, but once the sperm and egg come

together you have a fertilized egg - something called a zygote. Not a 'zygoat' - it's not only a goat embryo! So, a zygote is a fertilized egg. Here it is [draws on the flipchart]. A little DNA nucleus, organelles inside it, mitochondria, Golgi apparatus, endoplasmic reticulum.



When you read your biology text books you will read allusions to mechanism - the ribosomes are the machines that make proteins. The DNA obviously contains the genes that produce the protein to make the matter [of the cell], but there is a potential within that cell. There is some sort of wholeness, which is already there. I've thought about this and I can say, well, in an adult body we each have DNA in each of our cells and the DNA contains all the information required to make a body. But, actually, is that all we need? Is it just the case that the DNA contains all the information here? So, could you make the argument that actually it's simply the case that all the genes - the 30,000 genes of a human body that encode proteins that make a human body are all present within there [the nucleus] and then that cell divides and it divides again and it divides again. But the big mystery is how that information gets translated into some sort of three-dimensional form in time. So that's what developmental biologists have been struggling with for decades if not centuries.

So, with the machine analogy, if you can assemble a machine, you get the individual parts, you go and look at the blueprint and you provide forces from outside to put it together. So, Toyota can design a brilliant production line with external bits of machinery that all come together in this robotic way to create a Toyota Rav4 for example. The idea existed in an engineer's mind at some point and then created the machine - the car. But what I'm interested in is what is it about this egg that creates a whole person? So, from the point of view of physical development - biochemistry, DNA - it's all very interesting. But, what is it inside there other than just DNA, which is the driving force if you like? Is force the right word? Maybe not, because we get back into the idea of mechanism again. Is all the information, the 'whole' within the DNA or is there more than the DNA [required] to make the whole?

### **Beginning with the Potential of Wholeness**

And obviously if I'm a mechanistic, materialistic scientist I'll say it all comes from the DNA, all these little particles in the cells are machines that all come together in certain ways to make new cells and then they divide and eventually we get a human. We can delve into some of the details of that along the way. But, actually, what if we think of this [the zygote] as being "whole in itself"? Well doesn't

that define what a fertilized egg is? Because the wholeness has to be there at the beginning. Do you agree with that or disagree with that? There has to be some aspect of the wholeness, the idea of wholeness, or some aspiration towards wholeness, which is there at the beginning.

Thais: So, it's a holographic fragment.

Mike: Exactly, so the hologram - everyone's familiar with the hologram right? Yes, you could even think about it in physical terms - in terms of the DNA in each cell being a hologram. Because we know now that you can take nuclei out of cells and transplant them into other cells and create new beings. Dolly the sheep was cloned from a cell that was taken out [and transplanted into another cell]. So, in that sense, it's holographic in that you can take it out and grow it in a dish and make a whole new thing, a whole new person or sheep or whatever it is.....or ear.....they grew an ear on a mouse. Just because you can do it, you shouldn't necessarily do it right! So, the normal relationship again is between the parts and the whole. The whole is there already. The idea of the whole is there already. Or is it? Because this is just an undifferentiated egg. Or undifferentiated fertilized egg. So, even the parts aren't there yet. The whole isn't even there and the parts aren't even there. But the potential for the whole is there and the potential for the parts to get to the whole is there. Does that make sense?

### No-thing Transforming

So, there is another interesting way of thinking about this. This [the zygote] isn't yet a 'thing', in the sense that it is not a whole, it is not an adult. It hasn't developed into an adult or a baby that can be born yet. So, it's not a thing, but neither is it nothing. Nothing transforms into form. So, is there nothing in this egg? Well, there isn't nothing because there are already things that have come from the mother that are in here. Bits of information, things like messenger RNAs that are already in that egg that already contain some information. But, it's not nothing. So, maybe we should say...can we say 'no-thing'? Does that make a difference? It is the subtlety of language - one dash can completely change it. And why does it change it? Why do you think it changes it?

Brian: It's not identified, it's more potential.

Mike: Exactly, it's potential, yes. So, it's no-thing, but it is a thing. It's this paradox again - always the paradoxes. So, it's no-thing, but it's also complete in itself because it's a fertilized egg, which has this huge potential and also Philip's adage becomes true again.

*"Wholeness, it is said, contains everything about itself, within itself." Franses (2015) p 7.*

### Into the Mystery

So, a few of you mentioned meaning and fulfilment in life and feeling whole, being less fragmented. Because that's another thing that's come into society, the fragmentation. Fragmentation, to some extent comes out of the idea of mechanism, because we've got building blocks that we assemble to make something, a machine usually. But, actually the word wholeness also comes from, or is related

to, the word holy, so there is a sacred aspect to this as well. This potential, which is no-thing is...well, how can you describe it? You can't. You know, in the Tao you cannot describe no-thing. So, another statement of Philip's which I really like is.....sorry to pick on you with all your words of wisdom! ...it is "inhabit the mystery!"....has he said that to you yet? A few times? But, from my own point of view, as a scientist, one of the reasons I was so interested in the way cells develop. First of all, it's mysterious. It IS mysterious! How do you get from this no-thing to something that is whole? It's fascinating to understand the process; it can be enjoyable for its own sake. A lot of science these days is very technologically driven with outcomes required: biotechnology for particular purposes, to make GM crops or whatever. But, we can think about the implications about this way of thinking. The way developmental biologists think is different than the way a lot of other scientists think, [in terms of] of matter and determinism. So, we can get into determinism versus free will here. Because if this egg, which is no-thing contains the idea of a whole person within it, there has to be some element of determinism because I don't want to end up as a jelly fish. So, the genes will provide a certain amount of determinism - they will determine what happens in the end, but there is also quite a bit of free-will involved as well.

So this original fertilized egg is going to divide and divide and divide and form a ball of cells, (there are loads of names in embryology that I won't bore you with because the names tend to fix particular things in space at particular times, particular patterns, but of course this is an ongoing process). And so there is a point reached where you have a ball of cells, and essentially each cell in that early embryo still has the potential to develop into any other cell. So, the word is 'totipotent'. Each cell has the ability to form a whole new person, even if you take it out. And these are the so-called embryonic stem cells.

Isa: This is up to a certain point of development?

Mike: Exactly, and again, I'm just giving a little introduction here, a preamble really. So, think about it! This is a journey that we have all taken! Each one of us was this unfertilized egg initially and then we were this zygote with this unlimited wholeness, this unlimited potential. And of course, as a biologist, all I'm thinking about perhaps is the biology of how I get from a fertilized egg to a baby. But actually, it's very interesting to hear all your stories and your thoughts about where you've come from and where you're going because perhaps a different way of thinking about this is that we're still all developing. We are still part of this organismic process. And our problems perhaps with our situations are that we're kind of fitting into these boxes of mechanism when we are actually really organisms. Isn't that amazing! We're organisms! So, we have this egg here that is fertilized, which is the organism!

So, at the same time as Newton and Leibniz were developing the calculus, which I suppose was a way of seeing the world more dynamically, of being able to mathematically model dynamic change. And, as Philip says, Leibniz in particular was very holistic about it. I don't think you can be a developmental biologist or an embryologist without seeing the relationship between wholes and

parts, or at last reflecting on that because even modern developmental biologists who have a very reductionist methodology where they break [embryos] down into parts in order to analyse them and model them, they still ultimately have to put them all back together to get the greater understanding of what's going on. But of course where does the meaning come from? Where does the extra understanding come from? And so I think, from my own point of view, this is the thing that has been missing in biology - this issue of the meaning. And also, a genuine philosophical reflection on the fact that organisms are not machines, because many scientists do the experiments like they [organisms and maybe scientists too] are machines, but they don't understand or they don't reflect on the fact that organisms are not machines. There is more to it. There is this intangible issue of meaning. And also, where does the drive come from to actually make that egg develop? There is something intrinsic, some sort of inner force or internal drive that sets these things in motion.

### Zooming in

Interestingly, at about the same time that Leibniz and Newton were developing the calculus ...and Philip mentioned Hooke. So, Hooke was one of Newton's contemporaries, though he was at Oxford. He was a physicist and he did a lot on optics and he was the first to develop a microscope. And if you go online there are some fantastic drawings that Hooke did of microscopic phenomena. So, suddenly the world became a different world. So, Hooke managed to draw the eyes of a fly for example and he drew a flea, which looks like an absolute monster [laughter]. And nobody believed him! They said "You've made it up! That's not the way we see the world!" But, of course what the microscope did was to give us a completely different conception and perception of the world. But it also opened up ultimately, obviously, the ability to look into the beginnings of embryonic development and get back to a dynamic appreciation of the way that organisms develop. Because one of the issues with studying biological tissues, as Evelyn mentioned, is that generally you kill them and fix them and put them under a microscope and you think that you know something about the nature of biological systems. And also you tend to lose the idea that there is a wholeness here, a whole thing because you zoom into [the tissue], as Hooke did. He was the first to identify cells in cork. So, he was the first to come up with the concept of the cell. But, by going deeper and deeper and deeper, these new realms of reality were opened up. But perhaps, the argument might go, that we've lost something of the appreciation of the whole picture along the way.

So, I don't know if you guys have any thoughts on that or questions. I have something to read in a little bit from a book - the Seamon book on Goethean science. There is a nice chapter by Brady on this issue of organism versus machines and Kant's view on it, which might be interesting to reflect on.

### The Universe as Organism

Fabio: I have a question. You talked about your concern about where you focus. For me, there is not even a difference between that and the physics. And not even this distinction between the living or dead. It's also a distinction you make - that in the end it's all matter going to the limit, coming out of nothing, coming out of particles. So, I'm very intrigued to see where it's going to take us. So, in the

end, if you go back and back and back, it's the same question. You can decide to start with organisms, but it goes back further.

Mike: Absolutely right. So, you could argue, as people do, that actually after Newton we have a clockwork view of the universe, where we have the transcendental designer who sits outside and sets it all in motion. But, actually, the more recent views of physics could suggest that the universe itself is an organism. So, in a way, what we are looking at here with this no-thing in this fertilized egg. It could be considered to be something similar to what existed before the big bang. So, we are part of this ongoing, developmental, organismic process. So, from my point of view of studying cells and embryos for as many years as I did, because I've stopped now. But, it brings up the issue of where you draw the line between life and non-life and where does an organism begin?

### Inner 'Know-thing'

Evelyn: I just wanted to say...we were talking about from the zygote, from within itself and, at the moment, because we're exploring ideas, whether there's a force or a drive? So, it's like a knowing. So, there's a knowing in the zygote. So, for me, rather than thinking about it as a force, which pushes it out of something, it comes from within. It has an inner understanding or a knowing.

Philip: So, it should be a know-thing (k-n-o-w) [laughter]

Mike: A know-thing! Very good!

Alex: I like it!

Mike: There you are [writes on the flip chart] - a know-thing! A know-thing! A thing that knows! That's great!

Evelyn: I know there's more to come, but I had a sort of feeling about that right in this moment.

Mike: No, that's great. So, there's a knowledge again. Philip was talking about Cordoba and the pilgrimage. There is a knowledge that a journey is about to be undertaken. And there is a plan, there's a knowing that there is a journey and that there is an end point. But, at that point, once that zygote divides and begins to form different cells, those individual cells don't always know exactly where they're going to end up. They could end up as kidney cells or eye cells or muscle cells. So, there is a knowing, but there is also a responsiveness to external events. So, for example, with plants, you can have a plant with the same genotype, the same set of genes. But, in a different environment, it will develop in a different way to give a different phenotype, which is what it looks like.

Isa: Can I relate the state of potential to develop from the zygote to a seed that is dormant then and receives some information from the environment to develop like light or humidity.....something that

you can prepare or in a living animal, as soon as it is fertilized, there is this trigger, this way is open to develop an embryo straight off without having any other information - just to send it forward.

Mike: So...sorry....

Isa: Yes, confusing! [laughter]. So, you have a lot of seeds. And then the seeds can fall and can germinate, so if what seed germinates is because it has information to do that. Kind of something that triggers this development, otherwise it remains dormant. And in the zygote, once fertilized, it goes on until it is interrupted due to lack of resources or information that it's not perfect. So, is that comparable?

Mike: Yes, because there is always going to be communication between the cell and the environment. So, the environment could be the immediate environment of whatever cell is next to it giving it signals and information. Or it could be the wider environment. So fish lay eggs like caviar in the water. The eggs are immediately going to get information from the environment about how to develop. So, in that sense, they are more like seeds. So, the situation when you have a blastula implanted into the mother - the mother's health is going to very much influence the way it develops. There are interesting relationships between genes and the environment is one materialistic way of looking at things. But, my understanding is that there's also evidence of emotional states of the mother also affecting development. Those kinds of studies are beginning to creep into the mainstream. [Needs references!] So, you've got the whole mental state and emotional state of the mother also influencing the way the whole embryo develops.

### **The Organism in Kant's Argument**

Mike: I'd like to read you a little bit from a paper, which is in *Goethe's Way of Science, a Phenomenology of Nature*. So, it's by Ron Brady and the section is called *The Organism in Kant's Argument*.

*"In the 18th century, biology was still separated from physics and chemistry by a barrier. We still intuit the difference in the objects of these disciplines. As Aristotle once pointed out, unlike inert things, living things may be termed self-movers or self-changers. They carry the principle of their change within themselves. The methods by which the inorganic world could be understood did not seem capable of crossing into the realm of life. Some thinkers assumed that one must invoke a creator to account for the difference. Others assumed that it would be necessary to assume the existence of a vital force in addition to the forces already known. The next century would see the barrier crossed by a reductionist strategy, but on the eve of that change Immanuel Kant published his Critique of Judgement (1790), a work that foresaw both this solution and its cost.....Kant was acutely aware that our notion of life was formed by the sense of inward unity, an agency that produced and governed the organism from within. The inner agency could not be brought to understanding by a conceptual summary of its parts, as is the case with inorganic compositions. In its*

*earliest stages, in fact, the organism had yet to develop the organs by which its later existence would be supported, making the inward unity antecedent to the developing parts, a whole which makes its own parts necessary rather than a result of the combination of the parts. To the degree that the combination of parts may be said to be causal, each part aided in the production and maintenance of all the others, and all the others did the same for each. As a result, the physical organs had to be recognized as both cause and effect of themselves. The linear chain of causes by which mechanical events were understood here curled up in a circle depriving the chain of explanatory power." Brady (1998; p 90-91)*

So that really is what we've been discussing isn't it? And Kant, I think in the end, basically said "Look you Guys! Go off and study biological systems with your chemistry and your physics, but actually in the end you will never understand the inner driving principles of it". And that really is what biologists have done. They've modelled their experimentation on this materialistic Newtonian idea. But, they've kind of forgotten that Kant said actually you can't understand this inner principle [using those approaches]. And then of course Goethe comes along.

*[Philip: Goethe was able to suspend the world in the creative tension between whole and part. He actually used the dichotomy between whole and part, as the creative space in which the third term of meaning could come in. Instead of saying the whole is off limits to science, as Kant said, or the whole is taken over by the parts, which is where modern science has taken us, Goethe deliberately stays in the tension of the dichotomy of the whole and part, that the resolution of the nature of the organism reveals itself in its own terms.*

*Our inquiry implicitly follows Goethe's method.*

*So the story of the zygote that Mike tells exactly reflects this intention, of using the space of teaching as a growing point for developing the meaning of the organism of the class. The story is rich in leaving open the question of the zygote for further interpretation. We know some isolated facts about it, but our knowledge does not use up the potential of what the zygote can become. ]*

Isa: Maybe what he really meant is that you can't understand by this way of looking.

Mike: Well, there was the big discussion between Schiller and Goethe about all this. Schiller was from Kant's school and they were discussing Kant's argument and Goethe was trying to explain that he actually saw these things, these visions that he saw that helped him understand this inner driving principle. But, this is the thing....well, it's not a thing! [laughter] You see, language again. This is the idea.....no.....I don't know! We'll say 'thing'. This is the thing that modern materialist biologists won't acknowledge at least publicly. That they engage with the phenomenon they study and that's how they gain their insights and intuitions. If you interview them, as I've done, they will kind of say "Well actually, I've spent hours at the microscope looking at embryos and I've got these amazing ideas." But, that doesn't go into the papers. That doesn't get written into the papers.

Karina: So, they go into a different relationship with these things that they are studying. Establishing a communication with it.

Mike: Exactly

Karina: So, they can't say they are having great conversations with zygotes, but they are! I know!

Mike: Yes! They are!

Karina: And what about conversations with trees!

Mike: Yes, exactly. I hug trees, but I won't be going and telling my colleagues at the College that I go and hug trees on a regular basis, but maybe I should.

Isa: Not for now. Wait a few years!

Mike: The issue is that most scientists aren't philosophers. So, although...I think in what you were saying earlier [Evelyn] [about] the guy who wrote the preface to Newton's book *Principia*. [He] was saying "*What a great philosophy this is*". And, I assume in those days, philosophy, natural philosophy was basically science. As Heidegger says - science doesn't think. So, scientists...well, biologists first of all have physics envy for one thing [laughter]. But scientists aren't thinking about the implications all the time. A lot of this is driven by funding and the need to produce technology - fair enough. But, the wider implications are not being addressed. That's my view anyway and I think perhaps that's a general view.

Karina: So, what if the scientist who is talking to zygotes starts saying this publicly. How to change science - the way it's being done? How to wake up modern science from this numb state of existing without considering this other side. Would there be a way if the scientists came out and said, "Hey! This is what happens!" Like Einstein said or Goethe said....

### **Creativity and Science**

Mike: What I've been trying to do is open up conversations with scientists about their creative processes. The creative process of doing science. Because, again, when you're creative you can be in a state of flow. There is a lot of work that shows that the creative process is associated with a feeling of wholeness. So, scientists, when you talk to them, will often say, "I've spent hours or days at the microscope with this zygote. I'm in the zone, I'm like a violinist when I'm working and I'm getting these insights and intuitions. I'm getting creative insights!" So maybe that's the way in because they can handle the idea of creativity. The 'Ah Ha!' moment that comes from somewhere. They don't have to say where it comes from or acknowledge how they got it.

Karina: But then they have to prove this scientifically. Prove the science and mathematics and observations that they are right. They may not ever be able to do that.

These: The financing of it too has to be completely different.

Evelyn: As you were talking, I got the picture of the zygote there sort of alone with an inner knowing, but then if it....but if it just stays alone you can't rely on an outside force to tell it what to do next.

Mike: It's interesting because each of you is here as an individual cell and this class is an organism. As you've differentiated to get here, you each bring your skills and expertise as these cells will divide and develop in the embryo to become heart cells or cheek cells or eye cells or whatever. They are all part of the whole. But they are all complementary and they're greater than the sum of the part essentially. That is the important thing in the end.

### Stamping New Coins

Alex: I'm suddenly realizing how important it is to develop language for these qualities that doesn't destroy them, that actually holds them. This is the exact reason why I'm so in love with Heidegger's thinking - the question concerned technology because it's exactly that. Technology can either hold or it can force. It can move what is held to its own rhythm. I'm just thinking...I'm writing these things down and then all of a sudden I remember what Rumi says *"All this talk is like stamping new coins while the real work is being done outside by someone digging in the ground!"* And I keep remembering that whenever I see, I look at my paper and I look at these words and it suddenly becomes clear. All of this is pointing to something. It's all pointing at something. It doesn't exist by itself. It's pointing to something. And I can look at things later and think Hmmm that doesn't make any sense, like later. But, it's just because I'm only looking at the word and then forgetting the context. So, it's just...

Mike: The knowing!

Alex: The knowing...the knowing! It exists, it's tethered. I picture, like this is the anchor of something still flying up there, still moving, still going somewhere, changing.....

Mike: But keep it grounded!

Alex: Yes, but how do you keep it grounded... responsibly? That's the question I'm.....holding.

Fabio: That's an important question because .....Philip talked about when you read Leibniz who was worried about the monads.....it gets very [heady] and then you said we made a cut here and we're starting to look at organism. We could say that a rock has no reason to exist, it could be just random

particles, not organized and also annihilated and could be nothing maybe one day. So, where are we at here when we are trying to do even Goethean science? Because we can go to a level where it's just, Oh I got a whiff of this ephemeris monad of how the universe works. How do I.....? And Philip mentioned it's not the zero, it's not the one, it's somewhere in between. I'm not really sure I got this idea yet. But I think bringing [this] to a field like biology and practical knowledge might help me understand that. Because I'm still...it's either...it's very easy to see, it's either here or there. This middle ground is very difficult to experience right now for me.

Mike: Well, in terms of Goethean science, I suppose there must be something about consciousness, which yearns for expression... For example, in Goethe's work with plants, there is this idea of the archetype of the plant. So, surely, it must be because of the way we participate in the world, which is greatly opposed to the objective scientific method where everything is separate, reductionist, separated from us. So, what these scientists are doing somehow is they are tapping into these archetypes to receive that information. There is something fundamental about the need for these archetypes to express themselves. In German there is a word *entelechy*, which has to do with this inner drive, this inner yearning for expression. So, there are things that yearn to express themselves. So, archetypes yearn to be manifest in the world. And materialistic scientists will look at the representations if you like. Whereas the Goethean scientist, or the person who is open to these underlying formative principles, will be able to see them as Goethe did. So, Goethe [tried to] explain to Schiller that he could genuinely see these things.

### Crossing between two worlds

Fabio: So, I keep coming back to this question. It's not about scientists coming out in the open, because they're doing a different science. For me it's different...it doesn't make sense for me, for science. Under normal science, the objective is taking things apart and knowing them as just things. Whereas, actually, before I took it apart I spent time with the zygote. For me, it's a different science, it's a different objective. Because if he does that and he crosses this bridge, he can't even cross the bridge back into the old science. I'm having difficulty crossing the bridge back. Because, once he's gone there.... It's not about I'm publishing this paper in Nature, but before that I spent six months with it, because the results would be completely different than the objective.

Mike: Well there is a crisis in science at the moment about reproducibility [Reference required]. The scientists influencing the outcome of experiments...saved by the gong [lunchtime gong rings!]  
[laughter]

Philip: That is the terrain we're exploring. Can we develop a language that's allowing people to cross between those two worlds?

Fabio: You can cross one way, I can understand, but to me trying to cross back. This is where we bring wholeness in, if we even understand wholeness. But you can't give someone a paper on the

internet and explain, or even a class, of what is wholeness, they have to experience it. It doesn't make sense. I can't go back once I've come. I only see one movement. It's either you wait for people to cross this bridge and understand what wholeness is, rather than trying to cross it back.

Isa: But, I think the point is that they are denying that they are in contact with wholeness. Because what [Mike] did was research about the creative process of the mainstream scientists. And they, without admitting it, again said, OK I had this insight and then they took things to draw questions, but they don't admit it.

Fabio: But we are in this class and people think alike in this class, but I don't think the real world is really that naive. People use different techniques for investing. There are people who know investing who think it's just math. But people are using horoscopes and other things like that. But people in science are also doing other things. It doesn't fit the scientific mode. It's not a new issue, people have been doing it for a long time and not talking about it! So, in the end, for me...Ah, I forgot the point now!

Mike: it's lunch time

Fabio: For me, it's very interesting. What are we trying to get here? For me, it's trying to get to this experience of wholeness, which is great, but I still don't understand this ..the zero and the one. What are we trying to get here?

### **Inhabiting the Mystery**

Mike: But, isn't the question there "what are we trying to get?" the crux of the problem? Because, we need to '*inhabit the mystery*'!

Fabio: Right...

Mike: And our thinking is so hung up on outcomes. Actually.... this zygote has a knowing (with a k), but it's never become a fully-fledged organism before. It doesn't know what that is. It can't see what it is. So, there's something that is just accepting of a journey. I mean, in the beginning there were at least three of you who said I'm just here, I'm going to make the most of what I'm going to learn and I don't know where I'm going next. Great! That's where the possibilities are. Not to have any fixed or pre-conceived ideas about exactly where it is you want to go because once you do that, you chose the possibility, and you limit the outcomes. If you were to switch on a gene, and you can do this by transfecting these cells with particular genes, which will turn them immediately into neurons for example. I've done it. So, you can take embryonic stem cells and you can turn them into neurons. That limits all the other possibilities. And the only reason they turn into neurons is because you've provided some sort of external force or external information in a mechanistic way that forces them in that direction and you close down the possibilities... Ok shall we retire?

Isa: A better place to end!

Mike: Yes, I didn't get time, but [tomorrow] we will do a little fun game, which is related to embryology, but is not going to bore you to tears.....honest!

# Day 2: Tuesday

## Chapter 3

### Squiggles and scribbles in the becoming of light

*On this day, something quite difficult suggested itself. Given our trust of the space we had created between us, could we turn the physics of understanding light backward from the event of meaning at which we would arrive? Could we travel through the understanding until light illumined an active meaning back upon our journey of investigation?*

A minute's silence.

Philip: It is good to just dwell on two types of experience. Who can guess what those two types of experience are? I will give you a clue.

Ole: Matter and Meaning!

Philip: Yes

#### Introduction

Philip: Let's personalise this a bit. Just let our mind or heart dwell on two aspects or characteristics of our life.

Matter relates to a routine, where we are defined from outside, a thing that people push around, there is nothing special in us, adhering to labels of what other people say we are. Titiane said in her essay the fear of being in a routine, where nothing has meaning just doing this and then that.

Meaning describes a moment where everything comes together, where life presents us with something totally new and whole which we can commit to, that changes the direction of our life, a rebirth into what we didn't think was possible.

We have to appreciate that both of these states are possibilities. We are born with both these possibilities, as related aspects of life:

- a) being functional, doing a good job and meeting outside expectation,
- b) being creative, a vessel for something totally new to come in.

Sindhu: Could you say it again?

Philip: Both these possibilities are available in life. You are pushed from here to there, you do what you are supposed to, you are not very special in life, have your own territory. Or you can be this receptacle for something more to come in.

We recognise those two qualities in ourselves.

We might want to think about this for a while and share what we come up with.  
[Silence for a few minutes as people contemplate]

*[During the silence I contemplate the unique nature of the MSc Holistic Science course, where the medium is not the knowledge transferred, but the collective inquiry we are on. It is Mike, me, the students, who by slowing down, form the medium in which this journey into meaning is to be launched. By slowing down and going into each of our experience, we enter into the field of participation that we wish to explore for the purpose of this class.]*

### **Threshold experience**

Diana: We often say we cannot be comfortable on stage, if it comfortable, it is not like anything new is happening, so it is not interesting for the public. So I related this experience with meaning. But also I was thinking because I am writing about fear, so I am asking myself in the assignment how you can stay open to this place where everything is possible, where you are lost. Since it is not comfortable at all. Then I thought, it is not so much remaining as passing through it.

Sindhu: There was this one crazy bus ride, it was six hours but I had to change three or four buses. I had no ticket, nothing was confirmed, but I had to get to this place. And I just trusted on different types of transport, at one point I had to take a lift with a small van, every time just trusting the people on the way, finding meaning in these small things, everything coming together, the same in one way. I somehow started seeing even myself differently, trusting more the journeys.

Ole: Bringing meaning and matter together. Hitchhiking is becoming a routine for me, and I can trust in it and know I will somehow get somewhere and it will be good. But each time, each moment, there is this feeling of “you never know”, you only have the trust in the meaning. The routine is keeping in the flow, but every car you go with, every person, who is giving you a lift is new and opens up something you never could have imagined before. You have this familiar feeling of approaching people, asking them to take you, but always you meet new people, and always something new comes out. Even though I have hitchhiked with thousands of cars, none of them are same. There is never a thing as repetition. Each event is full of meaning.

Philip: Things coming together, something taking you on through the matter.  
We need to find justice in this separation of matter and meaning in science. We have to go on this journey to marry meaning and matter where they have been divided.

### **Surrender to a collective form**

To start this journey we are going to go back to where Mike took us yesterday, which is the zygote. Not long before it was a zygote, it would have been any old cell being knocked around, pushed from here to there and would not have any standing or specialness on its own. What happens when suddenly this complete transformation in its existence happens? It is any old cell before that.

This new possibility, this new whole meaning of what the cell can become, finds a way of entering into the purely material very ordinary entity, this membrane, this nucleus it was before. It is like the moment some of you have alluded to where something comes in that you don't expect. Something that calls you and attracts you. If you look at the cell, one minute the cell is this closed thing, it is competing with other cells, and the next minute everything in that cell is turned to this one whole destiny that it has taken into itself. Something incredible happens at that moment.

This matter, this thing that was a closed identity is transformed by this wholeness that comes in, which it recognises. Everything about the cell at that point then becomes committed to bringing this wholeness about. It completely changes its character, to become the receptacle of something far greater than itself, which manifestly enters into the cell. From that moment on everything that happens, every point of arising, every move that it makes is bound in this duty or service to this whole quality that has come in. This is true both at a cellular level, that everything that happens is committed to the whole being, but also at a meaning level. Something has entered into us that we have to remain true to.

Let us just focus on this moment. A collection of parts, this matter that we can describe, which seems quite unremarkable, opens up to this whole quality that is able to enter into it. The cell is able to make a vessel or receptacle for the wholeness to enter. It changes its rigid bounded state of isolated existence, which it was as a cell before. It welcomes in this quality. The cell becomes the medium in which wholeness is going to be transformed into existence. What happens at this moment in which this wholeness comes in? The whole cell turns around, so that all the activities from thenceforth are committed to serve and fulfil this macro-state, this identity, this quality of wholeness.

### Calling

What a challenge it is, that to this cell, which was one amongst many, this possibility makes itself known. For the cell, was nothing special. But this one cell is given this possibility to be the medium, the vehicle for this whole quality to arise. The wholeness is at the threshold, it hasn't yet disclosed itself in any way, it is something that has entered in, and yet it is still living amongst the possibilities.

This in-between state, this threshold of wholeness, has been entered like a doorway, but where the nature of the passage is totally unknown. This liminal space between what the cell has been and what it can become through this visitation of wholeness into its being, this is the true space between matter and meaning, in which science and spirit dwell. There is no separate explanation of how things are, as if there were just the parts and the theory. There is just the potential of in-betweenness.

The whole is at the threshold of coming in, and the parts are the receptive possibilities trying to give birth to that whole. They are still possibilities, nothing firm is there, yet the calling has been made. Wholeness has given its command, and from then on everything is in service to it. The possibilities

are faced with this challenge. How to give birth to the potential that has entered in, that is a completely different ground than simply an abstract random ground of happening, in which we are going to explain the parts. This ground is already cast in the wholeness it is going to become.

It is like you are on that journey. Somehow you know you are going to fulfil the journey for you have been given that task. You will do everything in your ability to fulfil that task, whatever it takes. So we cannot think it is simply a ground we are going to explain things on. Simply any everyday ground on which anything can happen of which this wholeness is one of them. It is completely different to that. What we want to look at is something like a grid of that which is wanting to be born.

Because this wholeness is universal, it is not something local, not just another material manifestation we can explain. This is something much bigger than just the matter of the parts. So in a way for that part to live up to that task it has been given, that challenge, the part itself has to become something universal. Its own possibility of becoming is the ground on which this wholeness is going to unfold.

### **Field of self-generation**

How are we going to have this grid in which the possibilities are going to deliver this wholeness? How do we describe the journey to something whole, which is more than any of the parts, which we can use to describe it. The parts are finite, yet the wholeness to which it is reaching, which has come into it as an invitation, is not bounded and finite.

What science does is explore this grid where the possibilities are themselves the path of that which is wanting to be born through it. From that moment which the wholeness enters, there is this dedicated ground of becoming. The finite is the path through which wholeness manifests, even though it looks impossible from the beginning.

Now science has in its wisdom understood two related grids and these are called fields. Two related grids of how we can form this ground of how 'part-ness' becomes whole, allows wholeness to be born through it. Maxwell, in the 1860's was looking at this phenomena and he realised you couldn't explain it just with matter. You needed another concept. And he came up with these two fields. So we are going to define:

a field = a grid of that wanting to be born through itself.

Maxwell identified two fields,

one the field of relationship, which was the squiggle E the other the field of identity, which was the scribble B.

*[Philip: Mathematics has this quality of describing nothing, just squiggles and symbols, through each other. So mathematics begins with a blank canvas. But onto that canvas of scribbles and symbols describing themselves in relationship, amazing things happen like light is described. All the squiggles and scribbles have to their name is an openness that a meaning might form through them once they are brought into relationship. So mathematics is not about matter, things that already have a weight to them, an identity, but about meaning, signs that become something in how they are combined with other signs.*

*Now Maxwell's squiggles and scribbles have a particularly amazing characteristic. If the squiggles and scribbles are set out in a particular way, then the meaning that gives expression to this symbolisation is a direct expression of the characteristic of light. But it is also allowed for that the symbolism only achieves its meaning, as light, when the squiggles and scribbles have finished their journey of investigating the necessary dance of their inquiry into connection. Light is described as the process in which the squiggles and scribbles take on a meaning by arriving at a point of insight ahead of where they set out, about the journey they have been on.*

*So if we see ourselves as squiggles and scribbles open to meaning, as gestures brave in the face of nothing but the empty space of the board, then we can also combine our inquiry into meaning, until like Maxwell, we encounter those structures of connection, that reveal our journey to an insight that has a physical meaning, of light. We come across the destination of the inquiry by seeing how we form together a medium of that wanting to be born through itself. And now there is an ambiguity, in whether this happens, in us as squiggles and scribbles, open to meaning, or in the schematics of light. We arrive, either way, at a point of illumination, in which the nature of light as meaning is posted, after the fact, on the journey to signify something together.*

*So we find the very essence of what this inquiry is about in the form of light that is born through us. This is the way we rely on light to develop within its care the secret of our innermost meaning.*

*When we solve the relationship of the squiggle E and the scribble B, we get a relationship that perfectly describes light (amongst many other things), being itself between the pre-impression of reality of the electric field, and the pre-impression of the magnetic field. Everything falls into place, identified no longer as squiggles and scribbles but as actual aspects of reality. But the squiggles and scribbles can actually wait until their dance is done, to know how the activity beforehand prepared for this revelation of light. Light is ahead of the game of how we know ourselves to be a squiggle or scribble as sign to a future meaning.]*

## **Light**

Maxwell had formulated these two grids, relating to the other, and self-relating, the E and the B. He then found a mathematics of how E changing B, B changing caused E, and two statements of identity of E and B, in other words a completely rounded way of relating these aspects together. This is pretty cool. These two ways of being the medium for the whole to come in, relate to each other in a very dynamic way. What Maxwell did in his equations was to formulate the way these two fields of possibilities interacted, had their own dance.

These two grids of identity and relationship come to definition when putting together the B and E. The field of interaction completes the definition of self-relation and inter-relation. The self-relation and inter-relation interact with each other. Maxwell formulated how these two fields of possibility had their own dance of B-E-ing.

In order for this zygote to enter a field of development, it has to surrender to these grids of possibility, of how self-relation and inter-relation can come to definition in their new collective form. The zygote has to launch itself into an activity that is going to generate the whole, as a manifest quality of its living.

This: Since we are getting into the maths we must trust Maxwell.

Philip: Yes we did calculus yesterday afternoon, to prepare us for Maxwell's equations today. For it is all about calculus. How the rate of change of the B affects the E. And the rate of the change of E affects the B.

The very simple equations, that Maxwell came up with, choreograph how B and E change to realise the other. There are many concrete examples of these interactions, such as the generation of an electric field, as in a dynamo, by the turning of a magnetic field; or the generation of a magnetic field, by an electric field, as in the doorbell, which Maxwell's equations were able to explain.

There is one particularly surprising phenomena which came out of these relationships. The B and the E could be interacting with each other, and co-generating each other without any physical content being expressed. The dance of the B and the E, the potential for self-relation and of inter-relation, communicating with each other, could go on, and on and on. And it would need a transmitter and a receiver but in between it would just be this dance of these two fields.

These equations of the wave of alternation of B and E had two types of solutions.

One solution of what this dance represented was there was a whole quality waiting in the future, the journey towards it, in which this dance of possibilities was happening, when it arrived then everything that had happened until then, would be explained, would fit into place. This involved backward causality, and was called an advanced wave. The wave lives itself in advance of meeting that arrival point, at which everything that has happened up until then, knows its place, it exactly realises what it then manifests. Something is lived without knowing why and at a given moment everything becomes revealed, at a given moment far in the future from where you begin.

Isa: Again you are taking faith to maths.

Because we are trying to heal this divide so we are talking about maths from the perspective of meaning. The advanced solution allows the state of wholeness and part, this threshold state, to exist in a latent state of potential, folded in on itself, following this quest not knowing how to fulfil itself, not limited by being imprisoned in time. The field is bringing information right through time, it is not constrained in space and time, there is information coming in from beyond space and time.

Thais: In the mathematical equation

Philip: Yes

Jörn: There are two solutions for the equations, a whole quality waiting in the future, and what is the other one?

The other solution to the equations of the dance of B and E is a minor discovery called electromagnetic waves, but as we are not so worried about matter at the moment, we do not have to worry about that. Electromagnetic waves are radio waves, mobile phone technology, x-rays. ....And light!

B and E, when we interpret them physically as Maxwell did, are the magnetic and electric fields. One of their qualities is that in the dance they do together, one of the solutions to their motion is the retarded wave of light. But what I am saying is that this other solution is also to do with light.

When we see that wholeness come in, it is often connected with light, we often see that possibility as in light.

Ole: That's beautiful

Philip: But this advanced solution, is about how is this wholeness that we have allowed in at the beginning transported and carried through the possibilities of the parts, so as to fulfil that wholeness at the end where everything knows its place. Everything we understand, we know in its right place. We are connecting this to light. It is still embedded in the world of phenomena. When we meet this point of realisation, when the whole expresses itself, then that event is always an event of light. I don't know if any of you have experienced that? It is also true of the Goethean process.

The realisation of the whole is completely light-filled. Not light-filled in the way that we have been able to control light. But the opposite, of going into that freedom, and allowing that wholeness that has come in to the zygote to initiate that journey.

### Insight

Mike: There is also that expression, insight, an inner vision.

Philip: Do you want to say more?

Mike: Well in the Goethean process you get the insight, when you see it, something coming into view and becoming seen. In terms of the zygote, when the egg meets the sperm there is this miraculous activation - something liminal. But we know from the science as well, that there is light produced at that point, when all these proteins become activated. Electromagnetic radiation is produced, and we can actually measure these bio-photons of light, within the cell.

Brian: Can you give an example?

Mike: One example of this I have been reading about is the way cells use light to signal to each other. So we can have cells in a dish here in a dark box, and you have another batch of cells in a culture here and there is a window between them. If we use glass for the window, the glass cuts out ultra violet light; if we use quartz for the window, ultra-violet and infrared light can be transferred. When we use quartz as the window and damage the cells in the box, the cells the other side of the window, also die or are stressed, even though we haven't done anything to them.

But with the glass window, the other culture of cells is unaffected. Light is used to signal essentially. The cells communicate their stress. This research into bio-photonics is about the coherence of light in bodily tissues.

Brian: The stressed cells signal with light and the others receive it.

Mike: Also with regard to light signalling and coherence between fertilised eggs, they synchronise, because these bio-photons are released.

Philip: What we are suggesting here is that it is not so much that the cells are signalling to achieve coherence. Morse code: I am damaged, please die in sympathy. The act of cohering we can understand through the grids of that wanting to be born through itself, or through the fields that realise light. The act of becoming itself is indicated by these fields of light.

Brian: So you think that this is a measurable light?

Mike: People have measured this phenomenon of light. If you think about this word insight; this sudden coherence and explosion of light – it makes sense to me in the way we have an insight. Somehow the cell has this insight, this knowing that it is going to be something. It does not know what it is yet. But it goes from no-thing to some-thing through this insight.

Brian: Incredible

Mike: Goethe has something nice to say about this, about eye development, which I am interested in. There is an inner light and an outer light and when these two meet, eyes develop. So light 'seeds' eyes, and eyes see light. There is an insight, at some point during embryonic development (this sounds poetic but the science is here with the bio-photons). At some point, there forms a certain field within the embryo, the eye field, a collection of cells within the embryo that define this field, this field of cells which will give rise to eyes. At some point they know, they have an insight, they are going to be eyes.

Brian: Thinking of the relationship game there was a rule that we followed, of being equidistant between two others. Is it possible that under certain conditions, that functioning as an egg cell, that a sperm cell comes in, another rule comes in, that realises a transformation.

Philip: That was like Goethe with the transformation from the leaf to the sepal to the petal; it is actually one gene that changes and then the whole organisational dance changes and you get a whole different organ.

The universe is seeking to find itself, life wants to find itself within the universe, and we are seeking to find ourselves within life. We are the field of what wants to be born through us. When we arrive at those moments then everything falls into place.

Fabio: Do you have one advanced wave or many coming from the future?

Philip: Many possibilities cohere for an advanced wave to happen. They all have to cohere in their possibilities. There is a communication that happens because the field is a ground of wholeness, so it is not an isolated thing that only knows itself.

Titiane: Are these two fields existing in a three dimensional space.

Philip: That wave of the E and the B has a particular form. It goes like this.

I am very bad at drawing.

The E changes and causes B and the B changes and causes E so you get this peculiar wave. It is always begun and received by something physical. So with light a moving electron within an atom emits light and your eye receives the wave, when it is able to respond to that frequency of light. But between this dance is not physical, but just a dance of these two fields.

Ole: Are they not overlapping

Philip: Yes you are right. It is doing both at the same time. Basically when E changes, realises B, and because B is changing it causes E to arise. There are two other equations.

What we have done today, and I think we really did do it, is return that justice of meaning and matter to science. That if we begin with meaning then we go much further. If we just try to understand science with the event of meaning, then we all experience that being reborn in the whole, then it is a living science, a science that is about how can wholeness come back into our lives, just like wholeness comes into the cell. Instead of trying to fit all the pieces of biology that we have named, into endless labels back into life, all we do is look at this one quality of wholeness appearing into the liminal space of the parts and then everything is already there. We do not have to bring the light in. The light is already there as part of the coherence.

Mike: David Bohm said matter is crystallised light.

Philip: Einstein  $E = mc^2$

Sindhu: You are looking at science through meaning. Don't you think that looking through meaning is something we cultivate to look at everything, including ourselves? So, then it just becomes natural. Then it is not separate. What I liked was the idea that the mathematical [approach] becomes this ultimate view of things - the matter is the relative bit. It is like you are becoming through the mathematical view, and then you come into being through matter.

Philip: We have to live meaning. We have to live meaning in the room or it would not have worked. Unless we live the meaning coming into being, nothing would have happened.

Sindhu: Constantly cultivating that view of looking at it through this equation, it becomes a circle.

Philip: It is another way of looking at Maxwell's solution. The mathematical equation has a solution to it that fits perfectly into the journey of meaning. Even biologically it fits because it is to do with coherence and how this journey of the zygote beings. The physics and the biology, are not at odds, they are the same statement

Sindhu: Biology is now seen through matter, but when we look differently we can equally see through meaning.

Philip: Let us stop or do you want to say one thing about what is going to happen after break?

Mike: We are going to play a game after the break, which might or might not fit into this. I do not want to say too much about it.



## Chapter 4

### The Awesome Zoom: Unfolding Meaning.

A minute's silence.

This session starts with a reading of a quote by Martin Buber by Alex:

*"This is the eternal origin of art that a human being confronts a form that wants to become a work through him. Not a figment of his soul but something that appears to the soul and demands the soul's creative power. What is required is a deed that a man does with his whole being; if he commits it and speaks with his being the basic word to the form that appears, then the creative power is released and the work comes into being. The deed involves a sacrifice and a risk. The sacrifice: infinite possibility is surrendered on the altar of the form; all that but a moment ago floated playfully through one's perspective has to be exterminated; none of it may penetrate into the work; the exclusiveness of such a confrontation demands this. The risk: the basic word can only be spoken with one's whole being; whoever commits himself may not hold back part of himself... I break it if I do not serve it properly, or it breaks me. The form that confronts me I cannot experience nor describe; I can only actualize it. And yet I see it, radiant in the splendor of the confrontation, far more clearly than all clarity of the experienced world... such work is creation, inventing is finding. Forming is discovery. As I actualize it, I uncover. I lead the form across, into the world of It."*

Martin Buber, excerpted in I and Thou (Walter Kaufmann translation)

Mike: And that leads perfectly into what we're going to do now. I'm not going to say very much other than to give you some very simple instructions in a minute. But, it also connects with what we did yesterday when we had discussions about the relationship between art and science and between insight and intuition, problem solving, experimentation, research, learning, wholeness, parts - all of these things. I'm going to give you each one or two cards. Karina is going to sit out and observe. I'm going to observe and so is Philip. If there's anyone else who wants to observe that's fine. The rule is that you can only describe those cards to other people, but there is a puzzle that needs to be solved (or is yearning to be solved)! Last year, I did it slightly differently, but I called it a problem and that confused people slightly, because it's not really a problem as such; it's a puzzle. There will be a point where you begin to understand what the solution might be about and at that point you will naturally get to the point where the cards can be revealed. And that's all I'm going to say. OK, does that make sense? No questions?

This: So, we can describe through any type of expression?

Mike: Yes. OK. Are you ready? [Mike proceeds to hand out the cards...Silence! Broken by giggling progressing to loud laughter when the students look at their cards!]<sup>1</sup>

Mike: You've probably realised by now, it has nothing to do with embryology! Hold your cards 'close to your chest'!

Thais: Who will start? Anyone?

Titiane: So, in my two cards I have one scene of a street and then I have this scene in a TV screen, so I feel like we are trying to see something at different levels. So that there is a TV screen and then I'm going inside and seeing the screen as one more image. And the screen is in front of someone in a desert.

Lea: I have a similar thing when I look at my pictures. You can only see the hands ...it looks like a boy or girl figure...and it makes a village of little houses, wooden houses probably. At first, I only saw the houses. But then I saw it's an actual village.

Diane: Maybe it's best to describe one at a time? Not mix both [cards]...I had the impression you were describing both at the same time.

Titiane: Yes, because they are linked. One is in the street and the other is in a TV screen, being watched by someone.

Diane: Ah, Ok

Alex: Mine is of a scene that's outside - it's more distant, I don't know if I can say what it is. It looks like a massive operation and then it zooms back. The other card is an advertising on a bus. It seems like...Ah I'm not going to jump into interpretation yet; I'm going to leave that.

Jörn: I've got also a desert scene where there is a man sitting in front of a TV. There is his horse grazing by a cactus and a trailer. The other one is on a boat with a swimming pool. People on a cruise, like a cruise ship and people jumping in, sitting in chairs.

Alex: So, who has cruise ships in their images?

Brenda: I have the view of sea, but seen from above.

Alex: OK

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<sup>1</sup> Zoom (Viking Kestrel picture books) <http://myparadigmshift.org/zoom-an-awesome-book-intiative/> and <http://www.amazon.co.uk/Zoom-Viking-Kestrel-picture-books/dp/06708580>

?: Me too

?: Me too

?: Me too:

[Much giggling]

Brenda: So, I guess it's also....

Isa: I have a view of Earth seen from space, very far. Then the other [card] is two boys in a window, from inside their houses seeing a 'cock' [makes the sound of a rooster].

?: A rooster!

Ida: Singing..... on the gate outside the door.

Diana: And does the door have the sky on it?

Isa: No, there is no door. The window is open and the boys are inside. And the rooster is on a small gate singing.

Diana: I have the same image as you, but from a bit further.

Fabio: I have a view from space, but closer.

?: Ah Ha!

?: Me too

Brian: Alright, so, it's about perspectives and levels of....Does anyone have a really small....?

*[At this point there is the sound of a mower outside, getting louder - it becomes really loud and really challenges the students to speak up and clearly...some of the transcript is inaudible here because of the sound of the mower].*

Brenda: I have a woman putting together houses.

Evelyn: I have a child in a chair reading a comic – that's the smallest thing.

Diane: I have a letter.

Evelyn: I have a letter being delivered by the sea.

Philip: Can you shout a bit louder?

Evelyn: I HAVE A LETTER BEING DELIVERED BY THE SEA!

Brian: A written letter or an alphabetical letter?

Evelyn: A mailed letter.

Thais: So, should we join people who are.....

Sindhu: I have an image of a girl putting houses together, but it's says 'Toys' so there is another perspective, [the mower miraculously and thankfully stops] so it seems like somebody else is putting this woman putting toys together.

Ole: I have something relating to that. I have a boy sitting in a chair. There is one shoe on and one shoe off and there is a bit of water by the side, so it looks like maybe he's sitting by the pool or maybe on a boat and he's half sleeping and he has a journal in his hand. I can barely read it. It says 'toys' and on this journal is a picture of a mother and child and a table and they're putting houses together or something.

Evelyn: I have that one, I have that one.

Ole: And the other, there is a street and I wouldn't have thought it would be a TV, but now it looks like a TV screen actually and like a foot, like a shoe half on the TV screen. And on this bus, which is just crossing the road, there is a big advertisement of a ship on it.

Alex: He hum...I have that.

Brenda: I'm getting a world within a world within a world, within a world, within a world..

Thais: So should we physically order ourselves?

Alex: Yes

Evelyn: Ah but we have two cards...

Sindhu: My other card is....

Alex: Can we pass our cards to the next one?

Diane: Somehow I feel like I need to be in between you and Isa...because one card is related to you and the other one....

Isa: The far Earth .....is farther away...OK...sorry..

Thais: Maybe we don't need to be in a linear...uh...maybe we can be in a...

Isa: Sorry about that...

Thais: .....infinity symbol...

Evelyn: ...who said it...something about wanting us to be in relation to both our cards.

Diana: I feel like I have one card related to you, somewhere in the sequence or something.... and the other one related to.... [mumbled, unclear]

Thais: So, we don't need to be in a linear sequence, we can be in other shapes...

Brenda: Especially because it would be so difficult to know in what part of the 'linear' we would be, it's impossible; it could be there, it could be part of the advertisement, it could be part of...

Evelyn: But we can tell each other that...

Ole: I think there might always be people with cards in between and then we can find a link, a relation.

Lea: But do we need to stick to our cards? I mean can't we not just make a line of cards...pattern of the cards...

Thais: He didn't say that was a rule...so yeah..

Brenda: Can we show the cards? [speaking to Mike]

Ole: Split them...

Alex: He isn't going to speak.

Thais: We don't need to show them.

Mike: Not yet.

Titiane: We can start by just saying it out loud. We can start with the Earth and then...

Fabio: Create a line

Titiane: It feels like next is: 'we say', 'we say', 'we say' then we might find it out..

Fabio: We can map it, we can draw it....1, 2, 3, 4...

Diane: So who has the bigger to the smallest thing?

This: My image of space is, there's a little bit of Earth here, but I can't really tell what it is. Then there's a tiny little part of space like that, so its probably one of the furthest away.

Fabio: So, that's right after Isa's, so mine is a piece of the earth, with clouds and we're zooming in to the Earth.

Emma: And I've got an aerial view, so I can just see an island and the sea.

Ida: I'm before actually, because I have the Earth from space as well, but I can't see the clouds very clearly...

Fabio: So, you're maybe even further out.

Brenda: But I also have an aerial view of a kind of an island, but I'm wondering if it's part of an advertisement, but it's on the bus...

Ole: No, it's not.

Brenda: It's not? OK

Ole: No, there is only a ship on there present. It's a view from the side actually.

Alex: Eh hmmm [agrees]

Brian: OK, so, who's got the next ones after Emma?

*[several people speaking at the same time; unclear]*

Fabio: I have the farm from the top - you can see the two kids in a window, but it's like zooming in to a farm building.

Diana: I have something, but it's from inside the room - two kids.

Fabio: Ok, so you're after...

Diana: It's like I'm in a hallway looking through the doorway, looking at the kids, looking outside

Titiane: I have a desert....

Jörn: I have a desert too.

Titiane: So, that might be....so that might come before?

Thais: Yes, my piece of Earth looks a little bit 'deserty'.

Fabio: Yes, but isn't the desert on the TV though?

Brenda [clearly and forcibly]: Are we trying to think very linear...from further away to closest?

Titiane: But, we had a sense that it was linear...

Brenda: It's about perspectives, worlds within worlds, but do we have to make it.....[unclear]

Sindhu: But just put down the cards...

Thais: But we can't show the cards...

Alex [eating toast]: Would it be fun to ask questions? Of any riddles that we've got..coz I've got a riddle... when Ole said about [laughter as Alex tries to speak with a mouthful of toast] the boy building a house with the Mum and his feet were in the water, the pool? Is that true?

Ole: Say it again!

*[Raucous laughter from everyone...!!!]*

Ole: I didn't listen to the last word!

Alex: Describe the image for me again please...

Ole: OK, so one image is of a boy sitting on a chair, he has a shoe, there is no shoe, there is a patch of water just like tripping and he has a journal in his hand and you can see the cover of the journal and he is sleeping - [he looks] like me maybe a bit, only more blond [laughter] - and the ship has a railing...so you say the ship has a railing?

Alex: Yeah, yeah, yeah! *[animated]*.

Thais: Ah!!

Alex: What's the colour of the floor, of the ground?

Ole: Of the ground? It's orange.

*[the interjection of Alex, to ask questions has invigorated the proceedings at this stage; talking is fast and there is lots of enthusiastic laughter as new insights are seen by the group]*

Alex: OK

Ole: Yellow of the railing and with blue joints...I wouldn't have thought, but it looks like a TV because you have the reflection of light on it a bit and you see just the tip of...it might be a shoe then?

*[this is wrong - the TV relates to the shoe of the cowboy in the desert not the shoe of the boy on the boat]*

?: Yes, it is, it is!

Jörn: I have a picture of this boy...

Ole: And then in the TV you have no .....yes, windows...you have the tall buildings on the side ...you have windows there, but there is no kid, like, looking in, so you have the street, and there is walking somebody [sic] across the street, which is very busy and you have a bus, which is just crossing and there is a big advertisement where you have a ship and just sideways from left and right....

Fabio: It's like a tourist spot all within itself!

Jörn: Yes, Olaf I've got the bigger view on the scene where the boy is sitting in his chair in front of the railing on the ship

Ole: Cool

Thais: how many people do you have on your ship?

[Laughter]

Jörn: One jumping in to the water, one woman sitting with her legs in the water, one boy just coming out of the water and this guy sitting in the chair.

Thais: So, like five?

Jörn: Yeah

Thais: Well I have seventeen!

*[laughter]*

Thais: I .....slightly further away probably.

Titiane: That's two different pictures.

Thais: No, it's still this ship.

Fabio: So, there's two pairs of scenes.

Thais: There are three now.

Titiane: The man in the desert is watching TV and in the TV is the scene of the street and then the scene of the street has a bus with a boat.

Fabio: So, that's a world in itself. I can't connect the two boys looking out of the window with that.

*[lots of people talking over each other]*

Ole: But there's a journal....and on this journal is a picture....maybe it has something to do with it. The picture shows...I just explained to you! [Laughter] I just say it for you...written in this corner is T-O ...something, maybe it's T-S or ...Y-S, I'm not sure. So, here is a table like this, here there is a mother with like a yellow shirt (it looks like a mother because it's bigger than a child) and on this table is a green farm-like it looks with some dots....it's not very....so, it looks like a farm, like buildings and they are having their hands in there. That's just as it looks like ...and there is on this side a little chair as well...

Evelyn: Yes, I have the same....

Fabio: And white walls with a red roof?

Ole: Yes, I have white walls and brownish roofs, but it's really like not at all defined on this picture

Sindhu: But I have the same picture that's well defined, what you have just said, which has....

*[the energy, enthusiasm, volume of the group continues to rise]*

Fabio: ...pigs and roosters....

Sindhu: ...a girl in a yellow blouse and a pink...

?: Shhhh shhhh [an attempt to stop people talking over each other!]

Sindhu: trousers

Ole: Pink trousers, exactly, with with some dots.

Sindhu: With some dots and red shoes and she is arranging houses on a green table so it's magnified. I think I have [it] more magnified.

Brian: And I think I've got one that goes after that....you can't see any external....so there's no hand or anything and it's hard to tell whether this is a toy or a model or a real thing, I'm wondering this now, but the next zoom in goes to something like closer to what you have...the rooster, a bunch of farm animals.

Isa: Yes, I have the two boys and the window opening outside and the boys seem to be inside and looking at the rooster. The rooster is very colourful, has a kind of a purple neck and a red body and blue feathers.

Fabio: I have the boys from the back, further away, so it's like I'm zooming out...further away...

Brenda [forceful and slightly irritated sounding]: So, what is the meaning? We're describing the matter....no? What colour are we seeing?

*[a lot of giggling]*

Thais: It's gotta be the parts....

Evelyn: I still have a question about who relates to the one I have where there's a tropical island and there's a messenger with a letter and man with children near him receiving a letter?

Sindhu: Yes, I have...

Evelyn: And does it look like that scene is in relation, for example, to the cruise ship in that image?

Fabio: Or the island.

Titiane: Yes, I can see an island...

Emma: Yeah, I can see an island. Mine is an aeroplane and I'm in an aeroplane as well seeing an island.

Diane: Yes, mine says 'via air mail'.

Sindhu: Mine is more just a part of the beach closer to it, but it has something.....

Brian: OK, so we've got a series of images moving one way or another. From big to small...maybe two different ones.

Thais: ...Relationships...

Jörn: So, what is the closest perspective we can get from space? So, is there say one that is very far away and which is the one that is closest to the Earth and what can you see there? Has anyone got this?

Fabio: Clouds and the blue.

Ida: Yes, me too.

Brian: Ida said she had like a.....

Jörn: Is there an island on it?

Ida: The one card is a blue planet, which is the Earth I guess from space - not many details - and the other card is, I'm up in the air and I can see a small plane in front of me and I can see the horizon and I can see islands underneath...

Brenda: Emma, then I think it's me and then Fabio in relation....you also have it..

Fabio: No, no, no! I have it further away. So, this image lands on the island. Is that it? And then you have the islands....

Diane: No, the island is inside of the envelope isn't it?...The bus...

Ole: No, no there is no island, the bus is only the ship...you get into the island, into the desert, to the TV, into the TV into the advertisement...

Thais: Into the what?

Ole: Into the TV.

Thais: Oh! [laughter]

Titiane: Does your island look like a red desert?

Evelyn: It's a big sandy beach.

Titiane: Because... out ...I think it's red.

Jörn: Yes, it's red. Can you see some of the details on the TV? There is a picture. Because mine is very far away.

Titiane: The TV is the scene that Ole has - it's the bus in the middle of the street

Ole: Ah OK.

Titiane: That's the main thing, but then I wonder how we get from an island to a red desert?

Ole: Yeah, I am very in the TV on this advertisement. ...there is no other...there is nothing so far.

Lea: Shall we talk about the letter now? The letter in the, in the...

*[people talking at the same time]*

Isa?: Is he delivering the letter?

Thais: She's reading the letter right now. *[humorously]*

Brian: I have a card that just shows a sort of a white background and a triangular form like mountains, but really sort of two dimensional, and it's just sort of a blotch of red. It kind of looks like a close up of the Canadian flag, but it's not....but ...it's really non-descript...so, a sort of white background and a red series of triangles.

Alex: Oh!

Sindhu: Triangles! Yes, that's in relation to this picture.....the girl with the yellow blouse on....

Alex: It might also be related to the cruise ship's smoke stacks, which are red and white...

*[the mower returns - someone shuts the window]*

Sindhu: It actually reads 'TOYS', so I think yours is magnified with the Y and a has a triangle.....I'm guessing that's the zoom.

Ole: This would mean that it zooms, in the picture, it zooms in different directions. So either on the farm and to the ...letters.

Thais: It could also be the ship's lifesaver because it's red and....

Alex: Yeah, it could.

Fabio: Does it start in space or is space a page in a book or something? Does anyone have any reference to space?

Brian: No, it doesn't seem like it.

Thais: An image of space and then...?

Fabio: .....an image of space within something else...

Thais: Like a book or something?

Ole: So, the letter is the only thing we can answer about where it fits in...is it?

Isa: It's not in an island? You have a plane landing on an island, coming in near to an island.

Brian: Maybe that has to do with the letter...air mail.

Fabio: Yes, somebody had a letter.

Diana: I have the letter in someone's hands and I can see some beach behind it.

Jörn: I think the missing link is between the desert and the island.

Titiane: Maybe in the letter, it is telling a story of a man in the desert.

Fabio: Watching TV.

Ole: So, the beach of the island is the same colour as the sand in the desert - is it true?

Evelyn: They're different.

Jörn: It is completely red, the whole desert.

Titane: Arizona.

Jörn: Yeah, Arizona.

Brenda: It could be a letter or a postcard...

Titane: So, both of those things say Arizona.

Jörn: Yeah.

Titiane: Oh, so it's a picture, it's not a real scene.

?: He hmmm!!

Brian: Yeah!

Jörn: Ah, maybe it's.....because yeah, it's a stamp!

?:It's a stamp!!!!

Group: Aaaaaghhhh! [And laughter]!

Mike: Ah Ha! Archimedes has spoken!

Ole: Does anybody else have somebody with a postcard?

Jörn: But, the edge is really like a stamp.

Isa: Aaaagh

*[short debate about whether it's a letter or a postcard]*

Fabio: It's a stamp on a letter. *[said with conviction]*

Titiane: Do you see the envelope?

*[much simultaneous talking]*

Evelyn: I can see the envelope and there is a stamp on it, but it's too....it's at the size of us, so I can't read any writing, but the stamp is red

Jörn: Is it red-ish?

Evelyn: The stamp is red-ish, it's red-ish...that's the desert.

Jörn: Yeah, yeah.

Thais: Are we missing anything else?

Titiane: Is anyone getting closer to the stamp maybe?

Fabio: So, the stamp has a desert and a man and a TV and from there what does it jump to?

Titiane: The man is watching TV, a TV showing a scene of kind of New York with a bus and a boat, there's a ship..

Ole: On the ship

Thais: On the bus advertising..

Titiane: On the bus, yes.

Alex: Yes, I see the ship.

Isa: And on the boat there's a boy...

Thais: And then we should see...

Brian: Perspective, reality.....

Thais: And then from the ship it goes to.....where?

Isa: To the boy on the chair, like...

*[Lots of people speaking at the same time]*

Jörn: If we zoom in from space then with this airplane...and was there someone having a scene at the beach? Someone, an envelope?

Evelyn: That's where the letter's being delivered on the tropical island.

Diana or Brenda?: We're still thinking linearly - the farm is not there.

?: We're almost there...

Fabio: The farm is there on the journal..

Ole: It's there...

Thais: In the kids' journal.

Evelyn: Yes, in the kids' journal.

Fabio: Where's the letter? It's in the aeroplane?

Diana: No, my card is just a letter first in a hand and I can see a beach behind.

Fabio: .....on the island, then there's the envelope, which takes you to your stamp, which takes you to the, to that...which takes you to the boat...

Thais: And then? Where's the space?

Fabio: ...which takes you to the journal, which takes....

Jörn: Space is the beginning...

Thais: I don't think there is a beginning.

Alex: Yeah, some part of it doesn't.....maybe it's just not referenced.

Thais: I think it goes in circles.

Diane: Yeah me too.

Fabio: Yes, but that's the point we asked - does anyone have space in another reference? And there was none.

Isa: I have the Earth...

Alex: Especially, the letter people...

Isa: I don't remember, you who has someone seeing TV?

Titiane: Yes, an image on the stamp.

Brian: On the stamp of the letter.

Fabio: So, it's Earth seen from space, airplane, island and on the island there's a letter, with a stamp, on the stamp there's a scene of red and the guy watching TV and inside that scene there is the scene of the boat, no the bus...

Titane: And watching TV in the desert..

Fabio: Yes, that's right...

Brian: He's got it!

Fabio: And then it goes from the bus to the boat and then on the boat there's this kid and the kid has a journal and on the journal there are people playing with toys and the toys are like a farm....

Isa: Houses.

Ole: Yeah, houses that's right.

Fabio: And then two kids looking out of the window..

Isa: With a rooster...

Fabio: With a rooster and.....

Brian: And then what? You after that?

Sindhu: No, I think...

Ole: You're before.....after me....

Brian: And I have the unexplained red triangles.

?: Which is a...

Thais: We need to fit that in somewhere.

Sindhu: I think it's maybe from the toys....

Fabio: We give up! *[laughter]*

Mike: No you don't!

Thais: We're almost there! Can I just...we were at the toys then there's a rooster.

Fabio; The toy houses become like an actual house, so it's another reality...and there's two kids in a window

Brian: Looking at a rooster.

Fabio: Looking out the window and then you have them looking out a window at a rooster.

Isa: Yes, I see them from the back. They are leaning on the window and looking outside. The rooster is on the gate.

Thais: And then what comes after that?

Fabio: Does anybody have a gate? Can you describe the scene better? Is there anything else?

Diane: Does anyone have a rooster surfing? *[humorously]*

Isa: OK, the boys - one is dressed in red and yellow and the other is dressed in green and white and they are leaning on this window, the window is green and the wall is light. So, outside is a wooden gate, a natural wooden colour with this coloured rooster on it and the background is like greyish.

Lea: Well my background is as bit more precise....it's probably exaggerated, but it might be a universe or something, but it's not a dark background, it's not a dark background it's light with dots on it ....it's just trying to put the beginning and the end together that I don't know what it is...

Isa: And strangely this background has the same dots as the boy..

Brian: Mine is the rooster comb against the white wall....

Collective Aaahhh!

Isa: Huh?

Brian: I think mine is the comb of the rooster. The red part like this and it's against a back wall because I have this thing just before you, I can just see the boys in this play area and there's a white wall behind the rooster that's really...

Isa: With this triangle thing...

Diane: White wall or the sky?

Brian: It's not the sky...hmmm, it could be the sky...

Isa: So, it's not the maple tree that is [the Canadian flag].

Fabio: So, we're on the white wall.

Lea: Or the sky.

Diana: I think it's not a wall.

Isa: It's a background.

Lea: So you're zooming in and.....

Fabio: You have the...a scene from that?

Lea: No!

Isa: And the Earth...

Thais: So, we end at the rooster's head?

?; Yeah

Thais: Is that the meaning of life? *[the whole class - laughter]*

Mike: I thought that was 42! So, what's the hypothesis here guys? Do you have one?

Thais: We are in inception...

Alex: That's a pretty good hypothesis.

Fabio: But we don't have the meaning yet. We didn't have the story ....

Brian: There's no meaning!

Mike: You're very close and now you've got a very good hypothesis, so how do you prove it now?

Ole: Put them together.

Titiane: Well, go then!

Mike: Well, you don't need to uncover them yet do you.

Evelyn: Do we tell a story?

Brian: Put together a meaning...somehow.

Fabio: Yeah.

Ole: Inaudible *[laughter]*. I don't want to give a meaning from the outside.

Brian: Well, or make up a story that makes sense Guys.

Ida: Yes, but the meaning is from the parts, so each of us alone, there's no meaning.

Titiane: But, each time we're plunging into this static reality, that's a stamp or a TV or an advertising and each time it comes back to life ...into a scene... and that bird at the end...your scenes seem alive in the farm....whereas it was on a picture on a screen, on a this on a that...

Isa: On the drawing of the boy that's on the ship on the stamp, that's....

Titiane: That's representations.

Isa: .....that's on the letter delivered by the plane that comes from outside.....the Earth is so far away...that's seen from so far away...that's life and the universe!

Mike: Do you want to lay them out now?

Thais: Sounds like an analogy for how organisations....

Philip: Lay them out upside down...

Mike: That would be the thing to do wouldn't it.

?: Turn them around...

Mike: because you've done a fantastic analysis.....and it's been very holistic in the sense that you all worked together. There was no kind of concept that you might go reductionist. In other words, you could have said, OK, we three will work together, we three and then we three and we'll share by breaking the problem down. You had this strange mixture of holism and analysis. For a bunch of holistic scientists you were incredibly hung up on details [*laughter*], which is great because it allowed you to solve the problem as a collective. The other thing that usually happens is that there's a complete stasis initially with people just going "Oh My God!" (and I saw that). And then there are usually one or two people who begin to lead it and you lead it and you even mentioned "zoom".

Alex: Yeah I think so.

Mike: Somebody did. So, anyway, if you want to really prove your hypothesis, as Philip said, what you should do now is figure out what order they go in, but don't reveal them yet.

Thais: Facing down.

Mike: Yes.

Alex: Oh my goodness...facing down, white cards up.

*[students begin to physically move and re-organise themselves]*

Thais: So, we need to start with the Earth.

Fabio: The view from the cosmos.

Alex: Maybe in a circle. Can we do a circle? Maybe not.

Thais: We don't know how it begins and then ends.

Alex: But intuitively that's what it feels like it should be.

Isa: So, this is just the Earth seen from space.

Thais: The Earth from space.

Ida: But I don't know how far away.

Isa: So, I see the whole Earth.

Ida: I see a part of it.

Fabio: My Earth takes about 80% of the card, only 20% space...

Alex: This is the process of coherence, actually it's not coherence, of structure....

*[lots of people speaking together]*

Emma: I'm in the sky

Ida: I'm in the sky too.

Emma: I'm in the sky and I can see quite a big plane and then I'm in the plane...so I can see the plane that takes off about 30% of the picture, but I'm inside the plane also...

Brenda: I'm inside the plane, but I can only see the window.

Emma: So you're closer than me.

Fabio: So, where are we at?

Brenda: We are approaching the island, I can see the window, but inside of the aeroplane.

Fabio: The island from above right?

Evelyn: I'm at ground level with the island.....at human scale.

Thais: Who has the island from above?

Fabio: Does anyone have the island from above? If not, it's you...

Ole: There is a gap. We are looking into the airplane...

*[people talking together]*

Evelyn: I'm exactly at human scale, so I can see the mountains in the distance. There's a person whose delivering the letter. You can see them from the waist up and there's a full size person beside....

Thais: I think you're before her.

Evelyn: ... and children and you can see the mountains in the background.

Sindhu: I think I'm before you.

Diana: Does anyone else have island?

Thais: I think it's the mail now right?

Diana: So, yes, I have here the letter, mainly the letter...

Jörn: So, I've got the close up of just the stamp.

Brian: That's it!

Titiane: Now I have the man and the screen and his shoe.

Fabio: We're now in the world of the stamp.

Ole: And I have the screen and the shoes, but only the tip.

Titiane: And I have the street, just the street scene without the shoe.

Ole: So, you see the advertisement quite well.

Titiane: Yeah.

Ole: Could you see people on the boat?

Alex: How well do you see the bus with the advertisement on it? Do you see the bus?

Titiane: I see the bus with the ship.

Alex: So, do you see all of the bus?

Titiane: Yes.

Alex: OK, so I have the one....does anyone have like.....coz I have a fairly close up of the bus.

Brian: That's it.

Alex: And then I have one afterwards, which is just at a smaller level.

Mike: I didn't shuffle properly!

Titiane: So, can you see the ad on your bus?

Alex: Yes, it's literally like this...

Ole: I can see it already...

Thais: I have the ship...

Fabio: On the bus or no?

Thais: No, I can't see the bus, just the ship.

Jörn: So, maybe I'm next with the close up on the ship.

Thais: What can you see?

Alex: Nice, that feels right.

Fabio: I have 17 people, he has 5 people.

[lots of people speaking together].

Sindhu: What's your picture again Ole?

Ole: It's a blond boy half asleep with this journal..

Evelyn: Can you see his head?

Ole: Yes, yes, yes.

Evelyn: Then I'm next I think....I can see where he's cut off a bit. It's the same boy reading in the comic that says 'Toys' outside, but he's cut off slightly, so I must be next.

Brenda: Then I have a woman with the toys.

Sindhu: And I have the woman with the toys.

Brenda: With the houses. I can barely read part of 'Toys' and I can see her, just one woman and the houses.

Sindhu: I can read the [word] 'Toys' properly.

Thais: Is it inside the journal?

Ole: It's on the journal.

Evelyn: It's on the cover.

Sindhu: So, I can see three fingers on the cover.

Thais: OK, OK. She can see three fingers...

Lea: Do you see the whole person, the whole woman?

Sindhu: Yes, on the cover

Lea: ...because I have the woman, only the arms and from the elbows...

Brenda: So, I should put mine afterwards - I can see the woman at the table leaning in, quite a close up.

Lea: But the whole woman.

Brenda: I can see the head and the blouse, but not the details of her pants.

Sindhu: But then can you see somebody inside and on the cover of the comic?

Lea: No, but for me it's not a comic! [a lesson in communication – comic or journal? It's actually a toy catalogue]

Ole: The cover of the journal.

Thais: And now?

Fabio: Now we have the toys.

Ole: We have this landscape...

Evelyn: The houses, the hands with the houses.

Brian: I'm next after that...I've got it closing in on the toys and you can see the farm animals and potentially the rooster!

Alex: Potentially!

Thais: It's either a rooster or a...[laughter]

Mike: A rooster that's not yet manifest, that's not yet fixed! Schroedinger's rooster!

[lots of people talking together]

Fabio: I have two buildings in a courtyard and it's looking out of the window.

Diane: So, this is the toy becoming a view from the farm.

Fabio: The toy houses became a house and there's two boys inside and they're looking out the window.

Isa: And I have the two boys looking from inside!

Diana: I have the same, a little bit further.....from the door inside the house....

Alex: Wow!

Diana: ...from a view inside the house.

*[The cards are being continually laid down upside down in order during this discussion]*

Fabio: So, wait, wait...so, you're before...

Diana: My picture is inside the house, like I'm in the hallway looking through a room.

Isa: So, OK yours first.

Brian: Yeah, that's right.

Isa: Then I'm zooming the boys. Then it's the rooster!

Ole: Cockadoodledoo!

Isa: And that's it!

Mike: So...

Thais: From the universe to the crest of the rooster!

*[A round of applause]*

Ole: Who wants to be the one person, like one after the other...shall we start?

The cards are then revealed! One by one!

Group: Wow! Woah! Wow! Oooh, clouds, clouds! Drum roll sounds being made! Intakes of breath! Yes! Nice letter! There's the desert, Arizona! There he is watching TV.

Philip: I don't think this was the cards you worked it out [with].

Thais: He is looking bored *[the boy reading the magazine on the cruise ship]*! Oh my God!

Ole: Oh cool, it was toys.

Brian: It's a catalogue or something!

Ole: Hang on, that's weird, here there is only one person...it looked like two..ah, no it's only one.

Thais: Where is the rooster? We're almost at the rooster.

The whole class: Yes! Woah. *[Applause, laughter and excitement! as the last card is revealed]*

Ole: That's the story!

Ole: So, tell a story - how do we get from there to there?

Mike: So, who's going to tell a story...where's our actress?

Diane: So, there was a rooster.... *[laughter]*

Ole: Once upon a time...

Philip: It was brilliant how you all got it all completely right!

Mike: That's the only time I've actually ever seen a group get it completely right [without looking at the cards]. *[Shrieks of approval and excitement!]* But as I said, you did it in a very holistic way, yes, but a very ordered problem solving, analytical way.....there was no chaos, there was very little complexity *[laughter]*. Last years I did this slightly differently - I used cards that had to do with embryology. There was a lot of chaos last year - people broke up into smaller groups, but they did a different puzzle and they got the answer in the end, but it was a different process completely.

Philip: Yeah, you didn't phase out...

Mike: Well done! You stuck to the task, you were very focused.

Philip: And how you got the stamp and the letter! That was incredible.

Titiane: Because I said it looks like Arizona and Jörn said, yes, it's written Arizona!

*[laughter]*

Jörn: So, I answered my own question.

Mike: You guys were also extremely good at communicating effectively and really listening to each other so that you could remember. So, the communication aspect to this was very important as well because it was the communication that brought these individual parts together as the whole thing. But again there was this silence, this stasis at the beginning, but it did gradually *[develop]*....and there was an Aha Ha! moment from you I think *[Jörn]* - the TV is on the stamp!

Isa: I was surprised because Evelyn just said a man with the child and then I saw the native people here.

Mike: Well at one point I knew that you had the journal that said toys and you just said I've got the journal, but if you had gone that little bit further and said look I've got toys on here that look like a farm you might have made that connection a little bit sooner.

Evelyn: Yes, because I was listening and not talking. It was like I was hearing things and I wasn't saying anything.

Mike: And there were other people who were just turning to me as if to look for confirmation or to ask ...you guys did very well. It was a very organised approach to solving the puzzle.

Fabio: There was a moment when Ole didn't really describe well his card with the boy. And we thought we could branch out in several directions - like what's in the background, could it be the sea? We hadn't established the link between the sky and the ship.

Ole: For me it was that I had both these cards....who was the first speaking? It was just after Titiane, I don't know why, I got the link between my two cards...of course between the boy and the ship...then I don't know why because I couldn't really see it but somehow it came out Oh yeah! There is a link also.....

Mike: What about the observers that didn't know what the solution to the puzzle was? Did you reach a point where you understood what was going on.

Philip: I thought it was funny that if you didn't have any cards then you weren't kind of in on the meaning, so the others were all as if they could get to the meaning if they had a card but because I didn't, I didn't think of trying to put the story together. It's like you were completely disempowered.

Mike: I didn't mean to do that to you Philip.

Philip: No, but it was like being a physicist and not understanding.

Isa: That is like trying to reach the whole without any parts!

Philip: Yes, yes that's right. Because you didn't have a part, so you didn't feel you could play and you were so evocative as if you were really going to get to a solution and I couldn't see why because for me it was like I didn't have any urge to play that game because I couldn't see any of the story. You needed that part.

*[This is such an important point about the necessity for full participation for meaning to appear!]*

Mike: But you got to the meaning didn't you through the effective communication.

Thais: Masked did help at some points - we counted.

Alex: I think frames helped too. I noticed whenever someone described the outsides of the image that was actually like a bridge in another way. So, like with the stamp for example....with the ridge. Or the first question I wanted to ask Ole was what is the colour of the floor because there were these frames that extend.

Isa: Also, we wanted to link who was before because when we are understanding about the zoom action we wanted to know who is before me, which is after me? So, it linked. At a certain point there were three groups - island, farm and the ship, the boat.....

Ole: Even this is a group itself...through the windows again.

Mike: The other thing here is that even though it's a linear series of cards, the meaning is enfolded within deeper meaning, within deeper meaning in that fractal-like way. So you were able to unfold it. So David Bohm talks about an implicate order where these potentialities exist that then become unfolded to create what he calls the explicate order. So, actually, until you turned the cards over, everything was implicate, other than your ability to communicate the ideas and create visions or visualisations of the cards. So, somehow, the idea of the red desert was able to be evoked in someone else's mind, maybe if they didn't have the card. But if they did have the card, then they could join up all this information, which is implicate, which is potential and then as a group you've unfolded it into something explicate, which is the final form. Until you turned it over there was only potential.

Brenda: And there was some simultaneous movement. We were going from the details of what does it mean.....getting into the colours.....what does that mean? How does that fit into the overall story? I think we were kind of joining [the cards] at the same time.

Mike: Exactly! It was such a collaborative project. Usually when I do this, there's always somebody who takes charge. "You do that, you do that! We'll break up into groups. Four of you over there, four there!" And so it was a very emergent process. But, at the same time, it was one of the few times, if ever, I've seen a big group work together in a very orderly way, in a very thorough almost analytical way to solve the problem, albeit through a holistic approach - a big picture approach.

Philip: That's holistic science!

Mike: Exactly..yeah! Yeah!

Alex: Actually, that's perfect...There actually was a bit of chaos in there, because there was exhibition - there was the desire, especially near the beginning, to have bits of order, once we started recognising OK there's the farm, the boat ....there were patterns, so once the patterns started emerging then there was that desire to order them and then there was that exhibition. But then there was an inhibition that came from within the group that kind of balanced it out and we

went back and forth a few times between the edges of those two, but we stayed, we didn't become polar.

Thais: Well, I think that was only possible because some people had good memories of the sequence. Because, if we didn't we might need other instruments to keep that structure going.

Mike: There was huge amount of exploration and there were definitely two or three people who did zone out. I won't name names, but there were definitely some people thinking "Oh my God, how much longer is this going to go on?" *[laughter]*

Isa: I want to acknowledge something...the open-ness, the open-minded Jörn! Because he got a card that it's written Arizona there's a man watching TV with horse in a kind of motorhome and he was OK with that you see! *[laughter]*...what is this man seeing looking at the TV in the middle of the desert so he was really open minded.

Mike: Well, he just described what he saw; he didn't impose any theories on it.

Isa: Yeah I know, but watching TV you know...in the desert!

Evelyn: It's like Alex was saying, there were kind of flurries of activity and excitement and then there were these sort of little stasis moments where it was sort of maybe we're not going to go there...it wasn't all the same.

Diane: It was like the equidistant game. One starts to run and one runs after and then one is stopping it feels like everyone is going to stop as well and then...

Ole: But it's good, it made some space for a new riddle to come. But, for me, what I find so touching and amazing is what you just said as well that we were all kind of leading it and none of us were really taking over and I haven't experienced this, well I have sometimes experienced this, but never in such a well-working place! In all your other education, it is so hard for people not to do this and often we say, well OK, if we really want to get a good group process then just decide who is taking which role. I really thank you, it was really good...

Mike: Well, the roles emerged...Well, with Brian...there was a little bit of ego there, when he realised it was actually the rooster's comb! *[laughter and much talking over each other enthusiastically]*

Thais: I call for free association on that one - just say whatever comes into your head!

Mike: What did you think it was a maple leaf? *[To Brian who is Canadian]*

Brian: Yes, that's what I thought it was!

Alex: That's pretty amazing!

Isa: Maybe who had this card didn't associate with this before I said.

Mike: So, the meaning always comes from the context. You can only describe the cards [fully] by the context.

Thais: Can I say something else about how we felt emotionally.

Mike: Yes, good point.

Thais: Because there was a lot of energy and finding the meaning as very exciting and we all got very involved with it. It was satisfying.

Mike: But I did see one or two people become slightly dis-engaged.

Thais: What happened to those people?

Mike: Well, there was just a look of boredom [*in retrospect I realise this was not entirely accurate*]. Sorry, I don't mean to pick on you [Diana] but you did dis-engage slightly towards the end of that whole exploratory process.....I don't know maybe you can reflect on that.

Diana: I don't understand what you just said. [*laughter*]

?: Not right now!

Isa: I think she knew where he [the boy] was!

Mike: Yes, so she had done her job...

Isa: Sorry, I had to leave to collect a delivery.

Mike: So, that was an interesting dynamic that you had to leave. But the other thing that happened was the noisy mower. All of a sudden nobody can hear each other. And Philip said well speak up, but actually you could have all moved closer or you could have spontaneously decided to speak up, but nobody did. There were people going "What, what? I can't hear"! This is the problem with the big groups, or it can be, that unexpected things like [the mower] happen and yet you stick with the method that you've set up and you don't modify it.

Titiane: I almost felt the need to have some kind of sign language because everyone's speaking, so you can't interrupt, but to have a sign to say speak louder or a sign to say something else...to have another level....

Isa: So, when I came back I was asked to describe more what I had so I understood that the group had grown into another level of understanding.

Mike: So, did you see it as a spiral?

Isa: Yes, I saw it as a spiral.

Jörn: It was these moments of flow and excitement and how getting to it and then refers to it another block or another riddle and this riddle then teased us to go further and deeper and there was a moment of "Ah, we don't know and how does this fit into the next big picture"? It was these widening circles of understanding.

Sindhu: I've just realised that there's a shift in the perspective in this. Until we go to the island we're all looking at it from here. And when you shift this picture - looking at it from the ocean....

Mike: Ah, that's the turning point!

Sindhu: I don't know it just...because we didn't really expect that, but I just went with intuition that it's the same....

Isa: Now you see from the eyes of the...

Sindhu: It moves to the mailman.

Mike: So, that's the point where it shifts.

Isa: You view it from our scale..

Evelyn: From our scale.

Mike: So, that's our scale isn't it.....so that's us coming in from here and from here. *[From both directions - both from space and from the rooster]*

Alex: Oh interesting!

Mike: You're right...you're the first person I think to realise that! This is called the 'Awesome Zoom' by the way.....the story, the set of pictures! It's a kids' story.

Titiane: The human experience is the turning point between the part and the whole!

Mike: Very good! Yes! Yes!

Philip: T'riffic! Yeah!

*[laughter]*

Titiane: There's something else that I was going to say - that I feel like we've been in this classroom for weeks talking about making meaning and in a way this was putting our ability as a group to work on matter to make meaning out of it. Coz, we haven't worked together on an actual material riddle and this was just that.

Mike: Good! And did you all feel, you were talking about feeling, did you feel that you all contributed equally? Maybe you took action and you described and you communicated at certain times, but you also stepped back and listened at certain times as well. So, the balance between the action and the reflection is really important, which is again what scientists do all the time. In fact, it comes up in the paper that Philip and I wrote (Franses and Wride, 2015) about phases of action and reflection. Outer arcs of attention and inner arcs of attention.

Alex: Yeah.

Diane: I see two different ways of pulling together as a group. Here I knew almost from the beginning that one of my cards was next to Isa and the other one was next to Evelyn and it was exactly like this. Here and here. So, if everyone understands at least where you .....at least one reference point that you can be beside of [or inside of], then it works....

*[It struck me (Mike) when transcribing that this point is actually about the relationship between relativity and meaning! So, maybe the puzzle somehow, in some embodied way, gave the students a first hand experience of relativity in the context of the unfolding of meaning and helped them understand the later teaching on relativity better/more easily/intuitively?].*

.... Like if everyone knows, I'm next to you, I'm next to you. But there is another way of creating in a group. For example, if everyone is walking in here and we have to create a 'L' shape together, so it's more like the complexity game. If one moves, I can't decide to be this part of the L and I'll be next to her, it doesn't work. Everyone has to look at each other together at the same time simultaneously to watch the L. It doesn't help. Like, I know my place is here and that's it!

Isa: Yes, of course you have your place, but if you're not paying attention of the others it wouldn't help to solve the riddle in this case.

Diane: No, I know! But if I don't do that, it works.

Mike: So, there's this thing again of identity in relationship [once again, something fundamental here about relativity and meaning]

Isa: Yes, because here we have the cards and the place you are establishing, but if you are forming an L you can shift.

Diane: Well, I need to be connected to everyone's describing to also know my place. If I wasn't listening to anyone I couldn't say that probably my place is next to Evelyn or yours. Nobody was about to say to dominate you. I had to be connected to everyone to know where I was supposed to fit.

Mike: And you had multiple identities as well because you had two cards most of you.

Isa: Only Emma had two sequential.

Emma: And Alex too.

Alex: No I had two.

Diane: And if Brian took these two together it would have been completely different.

Isa: Emma had these two, so she could have the zooming effect clear to her.

Philip: What was that thing of identity and relationship?

Alex: I had the bus and then the ship within that.

Evelyn: yes.

Ole: This one?

Alex: No, the next one.

Mike: [*responding to Philip*] In relation to the cards?

Philip: Yeah.

Evelyn: You had the boy.

Thais: That was a key because it was very hard to see that.

Mike: It was what you were saying...Sorry [to the group], Philip is just asking about identity and relationships and it was what you were saying [Diana], that you had an identity defined by the card you had (in actual fact you had two cards, so you had a multiple identity) but at the same time you were saying that the only way you could find a meaning or a context was in relationship to other people. In other words, in terms of what cards they had specifically. So, there were virtual, implicate patterns being set up that linked the process together in a kind of flow I suppose in terms of these inter-relationships just like these cells are moving together in an embryo. They each have their identities, but they're also being transformed in the process because in this process that you were engaged in you acquired new meaning during the process, you began to understand something that you didn't before. When we started, you didn't understand that this was a sequence that linked together and the only way through that was an acknowledgement of the identity you had in terms of the fixed cards, yes, but also the relationship of those cards with other cards. Does that make sense?

Philip: [unclear]

Mike: But then I get the impression there's been a bit of a transformation in the group or within individuals within the group as well? Because you were saying this was the first time that you had put this together that you'd put these ideas into practice.

Group: Mmmmmm

Mike: That's good

Sindhu: So, the fields, which is what you were talking about Philip, just merge.

Philip: Yeah.

Mike: So, what you did was to immediately set up a big field of all of you, which was actually pretty coherent and then it was only after one of us suggested [Philip] that you could put the cards upside down. And then you began to direct traffic [Fabio] - let's start with 'space', so all the space people came together all of a sudden, so the field broke up and coalesced into a smaller field, which was a more reductionist approach to the problem and then you all went back out to the field again and the next group came in and put their cards down, so there was this ebb and flow, ebb and flow.

Philip: Yeah, the field is where you were kind of saying something and you weren't quite sure how it fitted, so the field was this vague thing, but finding the relationships also defined the identity of the cards.

Mike: Yes, exactly.

Ole: Actually the idea of putting the cards down, upside down, in the centre came way before in the beginning already. I think you did say it once, I did say it once, but it wasn't time yet. Because this idea came up and I think all of us had this idea sometime.....let's put them down

Fabio: Yes, let's explore more.

Ole: But it wasn't time yet. So, it was really beautiful. You can see that there is time for something to come.

Mike: Well because time was marching on and it was getting towards one o'clock [laughter], you guys were still discussing, exploring, analysing, describing. I think one of us said, you've got a hypothesis what do you do now? So, how much longer would you have gone on exploring? When do you take action? When is the point where you are sufficiently coherent or understanding of what the problem is, or the puzzle is, to actually take action? Do you need to have everything worked out before you take action?

Thais: No

Jörn; No

Mike: You see...there was a kind of tacit fear in a way, because I've seen groups who would break up into groups of two and three and there would be incredible chaos but then they would start to...people might take action too soon - yes, but the danger is that you explore and you explore and you don't actually take any action or the other side of it is that you take action too soon and you mess it up.

Isa: I think if you take action then you find meaning.

Mike: A very good point. Exactly.

Isa: We found meaning, it was the zooming then we found the stamp and then the others go into a different level.

Diana: But, are you saying that talking about it and discussing is not action? Trying to solve?

Mike: To me the action would be physically getting the cards on the ground and turning them over and showing that that is the solution to the problem. To me, that's the action, like a 'real world' action. So, yes discussing and describing *is* action in the sense that you're moving your mouth and making meaning, but it's not action in the sense that....

Isa: I think for us the action was putting them down because we already knew the sequence because your Earth is bigger than mine because of the window.

This: Maybe the talking was the field.

Fabio: It's like we knew, but we only sort of knew.

Brenda: Wasn't the action also the appearing of the meaning? When we were saying, it's actually the stamp. I think that's also an action?

This: Yes, I think so. I think so.

Evelyn: There was also this thing about commitment.

Alex: Yeah commitment.

This: When we realised the transformation, the final form that it took.

Alex: Commitment.

Mike: But you could have taken physical action before and this didn't happen, but it does in some groups, somebody could have said "OK, you four go over there and discuss, and you four go over there!" or three or four of you could have got together and said, "I'm fed up with listening to this lot! let's do something!" So, the four of you move into the corner and then you really work together and because it's a smaller group you might be able to make the connection. You only get fragments of the meaning, but you might be able to take something back to the bigger group.

Diane: But in this case, if you split, it could be so random that it could be worse.

Isa: We could have split into boats, islands, farm.

Mike: But then you need an organiser or a co-ordinator! Even in the embryo there is a part called 'the organiser' which is involving in setting up the three layers in the embryo and 'directing traffic'; it tells which cells where to go!

Jörn: For me, it was holding the tension of not knowing long enough until the meaning [could] emerge.

Mike: Exactly, that's really well put!

Isa: I think we need to pay attention of the lunch! [laughter]

Evelyn: There'll be no food left for us!

Mike: So, let's go and find meaning in our lunch!

# Day 3: Wednesday

## Chapter 5

### **The Embryo: Unfolding New Meaning.**

*The session opens with Mike laying out cards of the stages of zebrafish embryonic development in a semi-circle. This is curled up on the floor in a kind of foetal / embryonic position! And so Mike is laying the cards around her and the cushions she lies on. There is some laughing and joking as this process takes place.*

*[laughter]*

Mike: You can reflect on the cards!

Isa: *[Speaking to Philip]* Ah, you are part of the distribution process?<sup>2</sup>

Philip: I'm being born!

Mike: So, maybe that's something to meditate on!

*[A minute's silence]*

### **Spiraling Meaning: Reflecting on the 'Awesome Zoom'**

Mike: OK, welcome back everybody. Today we are looking at novelty and transformation and what I thought might be useful initially is perhaps to reflect a little bit on the process yesterday. So, you probably see these cards laid out here - different cards! These cards represent the development of a zebrafish embryo. So, this goes at this end - fertilized egg, cells dividing and it goes right the way round to a fish-form at 4 days.

Zebrafish develop really quickly, so you can follow them under the microscope - they're beautiful! But, I think [regarding] the game yesterday, from my point of view, I thought you did really well. I hope that you could appreciate the kind of unfolding of meaning that occurred during the process and also the way that there were different stories within the whole thing, in terms of the zoom, so whether it was space or the boat or the toy. And, in a way, we've got the same kind of thing here, where the unfolding occurs within the embryo during each stage of development. So, even though we've split it up into individual stages with individual cards, there is an unfolding. So, that's just a little bit of a preamble really leading perhaps to a little bit of reflection on your experiences of that process yesterday, maybe in terms of an unfolding or a development or a communication...so.... the floor is open!

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<sup>2</sup> There is a sticker with Philip's name on, which has fallen off his sweater and is now on the floor amongst the cards.

Alex: It was interesting to notice the movement in the spiral before it became a spiral on the floor, because it felt like a spiral. It felt like the point of view of moving at this wonderful spiral rate through the image. And once Thais made it into a spiral, the invisible motion of it became the actual motion of it - it just felt right!

*[Silence and reflection for a while]*

Isa: Because it could also be the other way round - from the inside to the outside. It could be done from the rooster's head to the Universe. It could [also] have been done from outside to inside.<sup>3</sup>

Mike: Ok, yes and that's something that we can talk about today. There is this concept of upward causation versus downward causation in embryology, in the emergence of forms, in terms of self-organisation. So, you guys were, in my view, actually a very excellent self organising unit! Did you feel that?

Evelyn: I shared something with Mike yesterday afternoon – that, as we began to work as a whole, I had this wish that we stayed as a whole. I thought there could be a shift from somebody to say: “Should we subdivide or shall we have a different kind of conversation?”, which is my experience of group work or a set task. And I thought, well so be it, if it goes like that, it goes like that and I was almost holding my breath as we stayed like this, and people kept listening. So, I had that wish that we do this to see what it felt like to not break into groups, which is the more common gesture.

Isa: Did anyone think about breaking up yesterday?

*[Quiet 'No's from several people]*

Evelyn: You see, that's amazing.

Mike: And the way this embryo develops is a complete whole; it never breaks up. We can break it up, because we can take one of these individual cells here [*points to early stage embryo blastomere*], which is totipotent, and we can develop it in a dish, but we have to physically break it up to do that.

Isa: It was interesting, the point Sindhu raised, the shift of the point of view when we come from far away and seeing things from [space] and then from the human scene - the stamp. That was one moment. The second one was when we saw the boys inside the house - seeing the view and then going inside specifically.

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<sup>3</sup>An implicit understanding of relativity here already

Diana: Usually we think about the point of view coming first. But as we needed to describe what we had on the card, it's like we were inside first and then, as we explain, our point of view then appears [as] the meaning.

Isa: And also, I thought afterwards during the day, there was a trust in the descriptions and then there was also this seeing the value of the feeling of what it was doing in the group, because if Diana hadn't mentioned Arizona, then it [wouldn't have] clicked [with] Jörn and so these contributions that you think are silly or not useful sometimes, we keep them to ourselves maybe, but it was something that the group could use.

Thais: One thing that I thought was pretty amazing was that at first everyone was like "I have a ship!", "I have a ship too!" [and] "I have a ship with a couple of people!". So it just seemed like the same image [laughter], but then we had to actually really be attentive and describe and try to be specific about what we were seeing. And I think this comes from the training here [*in the previous module on Goethean Science*]. Ok, it's a plant and this is a leaf, and how is this a leaf?

Mike: And that enabled Alex's point about the meaning to spiral up and become more detailed. There are plenty of animals like snails that have this lovely spiraling pattern of development, which is a natural thing in nature - to see these spirals. So, it was amazing to witness the way it spiraled up. It would have been nice to have a bit longer. Well done!

### **Self-appearing and self-othering: the embryo emerges**

So, what I want to do today is to think about this concept of self-organisation, which is actually what you did. So, yesterday you acted as individual cells in this organism, which is your class. This concept of thinking about the class as an organism is something that may be useful. You all bring certain skills and experience and certain abilities as a collective to understand what you had on the cards and to be able to communicate that effectively. And again with regard to the embryo, and with regard to the cells in the embryo, they are engaged in this process of communication with each other [and] also finding themselves, in a way, through changing themselves. So, I think Philip had a couple of terms in his article [on parts and wholes]: self-appearing and self-othering and that really is what I want to talk to you about today in terms of embryo development, because that's basically what cells do as an embryo develops. They self-appear and they self-other.

### **The central dogma**

We can think about the role of the genes.... Is everyone familiar with the way we get from DNA, from genes to proteins? Would you like me to just remind you? [*laughter*]

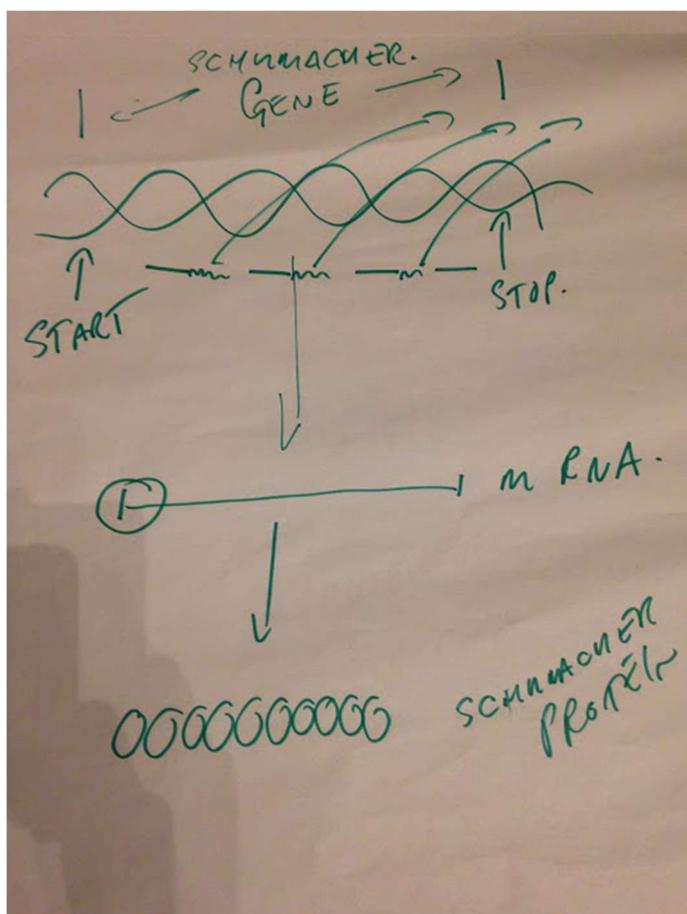
Karina: Yes, just a reminder!

Mike: Yes, sure. It's a key concept! Just as a slight aside, this makes me think of something. So, you know who Francis Crick is right? ...Are you messing up my embryo sequence? [*more laughter*] So, Francis Crick... [*Mike sighs histrionically*].

Philip: It's important...Look!<sup>4</sup>

Mike: You put a few cards down and then chaos reigns.....It's great!

So, you all know who Watson and Crick are - so they are the guys who worked out the structure of DNA. So, Francis Crick came up with this idea of what he called the 'central dogma of molecular biology'. So, there is interesting terminology. To have a dogma in science is something that's very interesting. But, in terms of DNA, genes and proteins.....just as a reminder [draws on flip chart], you have your DNA, the double helix within the nucleus, and the complete sequence of that DNA in the genome, including genes and all the regulatory elements that go with it.



We'll say that this unit here is a gene [draws on flip chart]. We'll call it the Schumacher gene and it wants to express itself. So, what happens is, you have what's called a start codon here and a stop codon here and then also you have little segments, which are called exons and these exons come together to make what's called messenger RNA. Does that make sense? There are other things called introns, which get spliced out and there is this term junk DNA, but none of it's really junk.

So, here we have our mRNA and then we get this machinery, we'll call it machinery, that comes in and binds to the start codon, a ribosome, and then that makes protein, a polypeptide sequence. And that's the Schumacher protein there, which will then do a job in the cell. Then it can be further modified; it can have sugars added to it for

example. This one-way information: DNA to mRNA to protein is what Crick called the central dogma. And that's the kind of upward causation idea, which is starting with the parts and making the whole and that's the reductionist view.

<sup>4</sup> This is when Philip's name sticker is seen in the sequence of embryo cards.

A slight digression, but it's relevant to what Philip talked about the other day when he was reading from the quantum biology book about the soul and that we didn't need a soul any more. I was reading this paper about organicism the other day - about self-organisation (Gilbert and Sarkar, 2000). I'll just read this bit here, because it's fascinating in terms of this upward causation idea that you start with genes and you go to proteins and you get life essentially. There is a section about a book by Nelkin and Lindee called "*The DNA mystique: the gene as cultural icon*" and it says that

*"...they see the cultural representations of genes as being similar to the Christian concept of soul i.e. an extract of the body that is the essence of selfhood, determines identity and character and from which the body can someday be physically resurrected (as in Jurassic Park). The gene functions culturally as the unchanging essence, the rock in the storm. Like science in general, genetics is seen as containing the underlying truth amidst social uncertainty."*

So, it's essentially a commentary on this idea of the gene and you've probably all read a bit of Richard Dawkins, or at least you've heard him.

Thais: I haven't.

Mike: So, Richard Dawkins is probably the most evangelical of all the Neo-Darwinists, the one who is most signed up to this mantra of the gene as the underlying unit [in all of biology]. But the point is, we don't need souls any more because the genes are the souls as far as this ideology is concerned. Also, the genes in biology are basically the equivalent of atoms in physics.

Isa: It's tricky because when you read it, it's so spiritual - the message, but in the end, it's just because he [believes he] knows.

Mike: Dawkins message? Yes, he's an excellent writer.

Isa: But, as far as he talks about souls, but in reality he is reductionist.

Brenda: He's a permanent atheist.

Mike: Though there are many scientists who are getting a bit fed up with Dawkins as well.

Jörn: Isn't he the one who has written *The God Delusion*?

Mike: I'd encourage you to all read a book by Rupert Sheldrake called *The Science Delusion*.

Does that make sense in terms of this dogma of genes going to mRNA going to protein? Well, the fact is, it's not as simple as this, because we now know, for example, about the HIV virus, which is a retrovirus. So, the mRNA can actually be made into DNA and then inserted back into the genome.

And also, the genes can't possibly do everything in all circumstances, because there are other examples, like when our immune systems develop. So, in the white blood cells, the way the immunoglobulins, the antibodies, are assembled is essentially by shuffling of the DNA together to make new sequences that make this amazing plethora of novel proteins, which are antibodies.

So, the genes are essential for making the proteins, which are the building blocks, but it's not just the beginning of the story. There is this bigger issue of self-organisation.

*[Laughter]*

Fabio: I'm happy!

Mike: You're happy! Good! There is also stuff in the media about the gene that causes this disease or that disease, so the public have got the wrong idea about the role of genes in life in general. There is also this disempowering message about "we are victims of our genes".

You can only have self-organisation if you have building blocks, if you have cells in the organism of your class who can solve a puzzle. So, that is really where we are in terms of how we get from a single cell to a whole fish or a whole person.

So, you've you done a little bit on self-organisation already have you?

### Happy lipids

The easiest one to understand is not to do with proteins, it's to do with lipids. Each cell in your body is bounded by a cell membrane, which is comprised of lipids. A lipid is a so-called amphipathic molecule: it has both a hydrophobic and a hydrophilic nature.

Isa: So, 'phil' depends on whether it's a friend or a foe.

Mike: Well, exactly. So lipids are both friends and foes of water. So, you have a happy lipid *[draws a lipid with a smiley face on the flip chart; laughter]* and he has little hydrophobic feet. He has massive great 'Welly' boots on made of rubber and his hat is spongy, so it soaks up water. He has hydrophobic feet and a hydrophilic head. So, the point is that this likes water [the head] and these [the feet] don't like water. If you put a load of lipid in water - you've all seen it when you put washing up liquid in water - it will form these self-organising units, so you can get something called a micelle formed initially, which is a lipid droplet. So, you start off with this situation... *[drawing on the flip chart]*.

So, here we are - individual little lipids, sitting around in a circle solving a card puzzle, self organising! The hydrophobic chains go into the middle here, because they like each other and this forms this self organising unit. And there are different variations on this theme, so that a vesicle can form where the hydrophobic units form, in a circle here, and their tails are going outwards. But what you can see here is that you have a bilayer with hydrophilic heads and hydrophobic tails that come together to form this vesicle, which is a bilayer. The reason that it can do this is because of the thermodynamics involved. What it does is to create order at the same time as it creates disorder. This micelle is an ordered structure in water and it ensures that, at the same time as the water molecules become more disordered, it becomes more ordered. So, it balances out. There is a thermodynamic element to the self-organisation to the structure.



What you can see here, though we're only talking about biochemistry at this point, if you know about cells, is that we have our original totipotent zygote here, because the bilayer is the cell membrane. So, at some point during evolution, there were lipids in water that self organised as bilayers that would then have further self-organised into cells and then we have the whole Lynn Margulis endosymbiotic theory, where prokaryotic bacteria invade these cells and they learn to live inside them. They contribute to the cells energetically and the cells provide a home. There's co-operation.

### Cellular self-organisation

So, that's a little overview of self-organisation with regard to lipids. But, we have something similar with DNA. We have the phosphate backbone, which is hydrophilic - it likes water. It also has the nucleotide base units in the middle of the spiral and these are hydrophobic - and they like to combine with each other. So, A goes with T and G goes with C. That's how the genetic code is set up. So, again, DNA is a self organising molecule. We can do the mathematics, the thermodynamics. We can also have a debate about whether DNA gets some sort of self-fulfillment from forming itself into a double helix [laughter]. Is there an internal agency within the DNA that means it likes to form a double helix?

Brenda: I'm just wondering about water - and as water becomes disordered it orders. What happens next? What you were referring to - as bacteria coming and so there being more energy?

Mike: Yes, so there's about a few million years of evolution there [laughter], but essentially what is happening is, and this is just one example of a self-organising system, within a cell you have all sorts of different sub-structures. For example, mitochondria are the equivalent of these little bacteria that at some point infiltrated the primitive cell. And the mitochondria provide energy for the cell and then that means that the cell can develop further. So, the cell can become more complex. So, for example, there might be other enzymes and proteins that are expressed that bring about some sort of specialisation in that cell.

Thais: And, they have this theory that the mitochondria is also a bacteria, because it has a little bit of DNA in it and it doesn't reproduce in the same way that the rest of the cell does.

Mike: And, interestingly, the mitochondria are all passed down through the maternal line. So, your mitochondria are exactly the same as your mother's mitochondria. The mitochondria then are providing energy for the whole cell and the whole cell is providing metabolic raw materials for the mitochondria. At every level, there is this relationship between the whole and the parts.

So, again, by staying the same - these lipid molecules are accepting the way they are in the world - they are actually assembling to produce something different. There is an emergence here. They're the same, but different. They are the same molecules, but they've organised into something, which is a vesicle, which now has the potential to become a cell, because every cell is bounded by this lipid bilayer. It isolates it from the rest of the environment, but it has also provided it with the boundary, the liminal space, by which it can communicate with its environment.

Isa: And it can differentiate what it has inside versus outside.

Mike: Exactly, so it can differentiate, and we will get into that. So, Ilya Prigogine was the guy who did a lot on self-organisation and he has this concept of bifurcation points, where, energetically, there's a point where something new suddenly emerges out of a kind of static situation. There is suddenly a new development into something different, which is exactly what happens during embryonic development. There is a period of time when a cell is quite happy to be as it is and then, because of this whole complex of genetic changes.....[looking at Alex and starting to giggle]...It worries me when you smile at me! [raucous laughter]. It's like "I know something you don't know!"

Alex: I'm just enjoying it!

Mike: I'll forgive you because you're Canadian!

Isa: It's poetry! Because you didn't see him doing this [takes deep meaningful and loud breath in]!

Mike: There's always one in a class!

Alex: What was his name again?

Mike: Did you just find the name amusing?

*[More shrieks of laughter]*

Alex: No! It's the bifurcation points - I literally wrote something last night about politics and bifurcation points, where the new and the old.....there's this point where the old has the chance to hold on to its structure, but there's always something new that's trying to emerge and ..yeah...it's...

Isa: The Canadian elections...

Mike: Prigogine calls them dissipative structures.

Alex: Dissipative structures...yeah, I noticed that...

Mike: *[writing dissipative on the flip chart]* OK, how many 'l's and 't's do I have? I've realised something through the years - that I'm actually a bit dyslexic! And I had no idea! I didn't know this! *[Writes 'dissipative' on the flip chart eventually after much juggling of 'l's and 't's']*. So, you can read up on that, as I'm by no means an expert. The point is that what happens is that, yes, lipids can organise into a very simple cell and then those cells can come together to form a clump of cells. The initial self-organisation following the formation of cells was probably the formation of sponges.

Thais: Do we know why they come together?

Mike: Well, the main thing that has to happen is that they have to express.....So, this is really interesting. So, why do they want to come together? The scientific, biochemical explanation is that they begin to express [certain genes], because this is another term in biology that a gene is 'expressed'. So, that's what's happening when a gene goes from DNA, to mRNA to protein - that gene is expressing itself. What has to happen, if those individual cells, that are, to all intents and purposes completely isolated from each other, if they are to come together, if they want to come together, they have to produce proteins called cell adhesion molecules (CAMs), which sit in the cell membranes. Gerald Edelman<sup>5</sup> won the Nobel Prize for identifying these things, they're so important. So, cells cannot come together until they've evolved the ability to express cell adhesion molecules.<sup>6</sup>

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<sup>6</sup>Edelman actually got the Nobel Prize for discovering antibodies, but what is fascinating is that according to Edelman's Wikipedia entry [https://en.wikipedia.org/wiki/Gerald\\_Edelman](https://en.wikipedia.org/wiki/Gerald_Edelman)

*"One of the most significant discoveries made in this research is that the precursor gene for the neural cell adhesion molecule gave rise in evolution to the entire molecular system of adaptive immunity."*

Now what brings that about? That's the mystery.

Thais: Love!

Mike: Maybe it's love! Yes! There is a need to evolve new meaning presumably. They want to come together. Brian Goodwin, who used to teach here, said that through the evolution of humanity and the development of science that gravity replaced love.

Isa: He said that gravity is Gaia expressing her love.

Alex: He said that love is metaphysical gravity. I love that, it's really simple.

Mike: Yes, that's basically it! So, if you think about it, you've got a kind of metaphysical gravity with these cells that want to come together and they have a yearning, a kind of inner drive, to come together. So, how do they do that? There's a potential there within them to produce these cell adhesion molecules and then at some point, it's like [makes the sound of a straining cell] and then "Got it!" I've produced a cell adhesion molecule! [giggling]

Brenda: Mike, this reminds me of the conversation we had over dinner when I asked you "So when does life begin?" and now I can see what you meant!

Mike: I had trouble answering that didn't I!

Brenda: Mike was saying there can be life in all cells.<sup>7</sup>

### **The Universe as organism**

Mike: The major thing there I suppose, as an aside, is where does consciousness come from? As far as mainstream science is concerned consciousness, our consciousness, is an epiphenomenon of the nervous system but [another view] is that there must be something fundamental about matter, which has some aspect of consciousness [within it]. I'm not saying that electrons can read The Guardian newspaper at breakfast and make sense of it, but what I'm saying is, and my view is, that the whole universe is an organism and I think Stephan [Harding] agrees with that too. So, [the

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In other words, the molecules that regulate cell adhesion (the molecules required for the connections to be made between self and other - to glue cells together) are related to the same molecules, which regulate the immune response in recognising the differences between self and other.

<sup>7</sup> What Brenda meant is that there is some sort of basic awareness or consciousness or feeling in all cells – things that define 'Life'.

question] "when does life begin?" is a [difficult one]. As far as I'm concerned, there are different expressions of life.

Isa: I am just digesting this idea of the universe being an organism.

Mike: So, we can talk about development of an embryo, we have to start somewhere and yet "As Above, So Below" that hermetic dictum. If you think of the universe as a self-differentiating Being then we're all part of that, just as a cell is a part of this self-differentiation experiment or exploration.

Fabio: What was this concept of Maturana and Varela? Because they were studying this.

Mike: Yes, they had a concept of autopoiesis, which provides a scientific explanation, in terms of emergence and self-organisation, for this inner-agency, this inner drive. Ultimately, you can model it according to thermodynamics and you can do all that mathematics, but I don't personally believe that it gets you down to this fundamental level of the inner agency that Aristotle talked about. So, Plato has the ideal forms, he's the idealist. He's saying I suppose that this embryo is putting into matter this idea of a fully formed fish in this sense. Aristotle is saying that there is this inner agency that yearns for expression. So, this urge for cells to come together results in the expression of these cell adhesion molecules that actually then brings them all together to form that original metazoan. That's the word for the original multicellular organism, which is like a sponge.

Thais: And they say it's a sponge because it's the simplest structure.

Mike: And you can produce antibodies against specific cell adhesion molecules that cause the sponge cells to break apart again. Antibodies are used a lot in developmental biology or identifying individual proteins. So, are you all familiar with the concept of an antibody? So, if you have your metazoan here [drawing on the flip chart]; this is a four cell metazoan creature. The cell adhesion molecules are like bits of glue and they come together to stick the cells together. Then, what you can do is add these antibodies, which recognise these cell adhesion molecules and bind them, so that these can't stick together anymore, so they fall apart to go back to individual cells again.



Isa: Is this permanent?

Mike: Provided you've still got the antibodies there that cancel out the cell adhesion molecules. If you then dilute out the antibodies, the cells will clump together again - it's a reversible process. So, that is a preamble about some molecular aspects of self-organisation.

### **Polarisation and progression**

What I want to do now is to say a little bit about what happens next in terms of this original cell, the zygote. Already, within this cell, there is a polarization [drawing on flip chart]. There are mRNAs that come from the mother and there are, as I said, mitochondria that come from the mother. There are [also] other proteins, which are distributed in a gradient. For example, there is a protein called bicoid (don't ask why!). A lot of these genes were discovered in *Drosophila* (fruit flies). People came up with various strange names for them, usually based on the mutation in the flies that occurs when that gene is knocked out. So, there's one called *eyeless* for example, which results in flies without eyes and it's due to a mutation in a gene called *Pax6*, which is a gene involved in regulating eye development. So, you can have a gradient already. As soon as the sperm enters the egg, you have this unlimited, undifferentiated potential, but pretty much right away there is a polarisation that occurs. So, there might be a higher concentration of the protein at this end than there is at this end. So, it's almost like the yin and yang thing again. You have the yin and yang appearing within the cell.

The polarisation then sets up the axis of the body right away. The head and the tail are already there because [of the way the proteins are distributed]. For the sake of argument we'll say we have a high concentration of this green protein here and a low concentration here. So, what will happen is that the cell will divide into two, then four, then eight and then sixteen - there's this logarithmic division. So, it's like that thing in the Tao about how the one becomes the many.

*"Tao gives birth to one,  
 One gives birth to two,  
 Two gives birth to three,  
 Three gives birth to ten thousand beings.  
 Ten thousand beings carry yin on their backs and embrace yang in their front,  
 Blending these two vital breaths to attain harmony."*

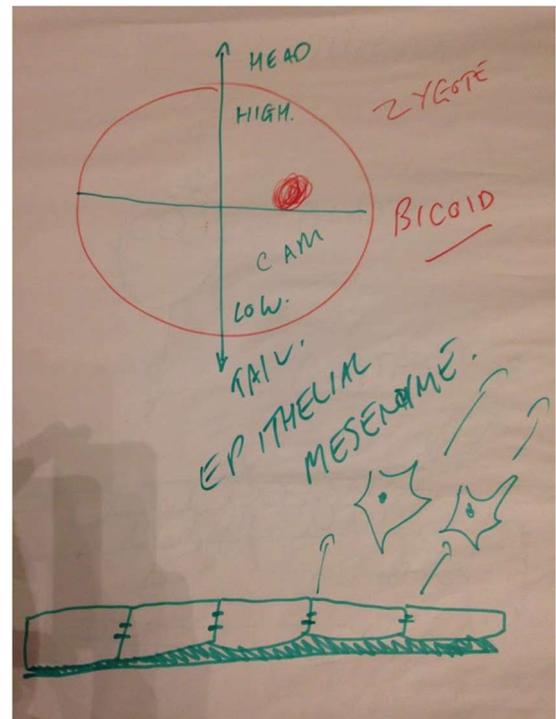
Again, it is this constant distribution of protein. So, every time this cell divides, the proteins are being distributed differently into each cell. So, you could imagine a situation where a certain kind of cell adhesion molecule gets transported into this part of the cell, which then goes into the next cell and then goes into the next cell and it's being continually formed all the time. But what that means is - this idea of upward causation - the genes are producing specific proteins like the cell adhesion molecules, which will then bring about certain changes in form, in shape, in particular cells at particular stages of development.

Brenda: There is so much possibility for error here.

Mike: Well, that's the amazing thing! I've got three kids and I've been there at all their births and I've seen all the ultrasound scans and it just never ceases to amaze me, the way that this works so well. But, of course, there are pressures during the process of development that will weed out anything that isn't quite right genetically or morphologically and this has been going on through every generation through the whole of evolution. So, it is utterly amazing, I agree!

### Cells self-differencing

This whole process results in formation of different kinds of cells. If we come back to our cell adhesion molecules and back to our idea of the lipids and the cells and the membranes and the way the cells organise embryonically, now there are two kinds of cells: the epithelium, epithelial cells and there are so called mesenchymal cells. I'll explain what they are in a minute! An epithelium is a layer of cells, which is like this [drawing on flip chart] and these will be bound together by cell adhesion molecules. An epithelium sits on a thick basement membrane, which is a matrix of proteins and



collagens and laminin and other chemicals that are produced by these cells. It is a substrate that they sit on. So, in embryos, what happens is that you start to get formation of these epithelia, because certain cell adhesion molecules are expressed in certain places at certain times. But, what can happen then is that at a certain stage of development, through an inner agency, through switching on and off of genes, of transcription factors that regulate further gene expression, just like with the antibodies (and I'm not saying that antibodies are usually involved in the embryo in knocking down these cell adhesion molecules), but you might get breakdown of these proteins which stop the cells from sticking together. What happens then is that these cells can release themselves from the epithelium and go off travelling! So, they can go off and explore and go to other places in the embryo, but usually they're guided very specifically along particular pathways.<sup>8</sup>

This business of going from epithelium to mesenchyme and from mesenchyme back to epithelium goes on all the time. So, again, you can think of the epithelium as being a whole within which these individual [potential] mesenchyme cells are present, but they can go off and become individualised.

The disease, which this is related to, is cancer. So, in an adult tissue, if there are problems with certain genes or proteins that are involved in holding epithelia together then you can get what's called metastasis, which is when these cells go off and populate other parts of the body. They go nuts! They're just cells out of control. They're like delinquent children who have broken the chains of restriction of this homeostasis, which is essential for this maintenance of the body. They have actually gone off and gone nuts! But this is a natural process during embryonic development, and it's much more regulated.

Sindhu: At what stage does this happen? Does this happen constantly?

Mike: Yes, this is happening pretty much constantly at different stages. There are particular stages of embryonic development and the first stage that this occurs during is a stage called gastrulation. There's a famous developmental biologist called Lewis Wolpert who says that "Gastrulation is more important than birth marriage or death!" The reason is that even early on [in development] this polarity is set up, so you already have the idea of the head and the tail. Gastrulation is the [stage] where that begins to become physically manifest.

Evelyn: I want to create a bit of an image in my mind, to see if I'm getting it right now. So many cells now and there's a polarity, so is it OK to picture them as a sort of ball?

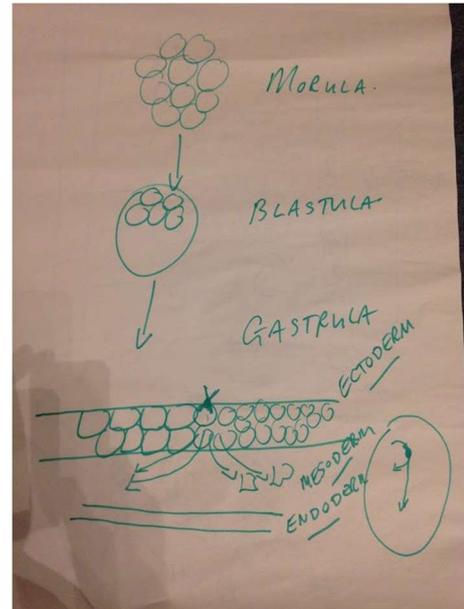
### Naming the stages

Mike: So, good point, it varies according to species. Initially, yes there is a ball of cells. So, I'll have to bore you a little bit with some terminology [draws on flip chart]. So, we have our zygote and this

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<sup>8</sup>I'm thinking of the labyrinth here and Isa's essay for this module; this is a good metaphor for this journey of the cells, since they are guided - they don't have unlimited freedom, neither are they as restricted (or as potentially confused) as they would be in a maze.

divides to form a ball of cells called a morula. And then this ball of cells self-differentiates and there's a cavity that develops. This is the point in human embryonic development where you get implantation [into the wall of the uterus] and this is called a blastula. The next stage is where you get gastrulation. And this is called a gastrula. A lot of this comes from German work - the German's were fantastic embryologists in the 1930s. There were a lot of embryologists who left Germany for political reasons. So, depending on the embryo, you can have a ball of cells [picking up zebrafish embryo cards from the ring on the floor and showing them to the students while speaking]. So, what we've got here is a ball of cells. This is a yolk sack and then the ball of cells sits on top. Then this is the point where you begin to get gastrulation beginning. So, what you have with a chick embryo (I worked a lot on chick embryos in my PhD work) is actually a flat disk, which is an epithelium. Are you OK? [speaking to Brian]



Brian: So, chick embryo.....you mean chickens... [laughter]

Mike: Yes, we used to get them from the farm. It's the dry [Canadian] sense of humour I miss! Canadians eh! So, what happens in the chick embryo is that...chicken embryo, is that you have a layer<sup>9</sup> of cells which is an epithelium. But, at this stage, this is only one layer. So, this is an epithelium containing individual cells. So, the problem is of course, we have many layers in our body. So, how do we get to two layers or three layers? So, we have our outer layer, our middle layer and our inner layer. So, the challenge is to get from one layer to two layers and then to three layers. So, this is where a bit of creative thinking and visualisation comes in.

There is a point here where the epithelium begins to break down, because the cell adhesion molecules are being broken down. So, if you look at the chick embryo from above, you have a flat disk, but what you have is the beginning of a little hole here<sup>10</sup>. This would be the head end and this would be the tail end. What happens is that these cells migrate inside this hole and they go inside the embryo. During development, this movement goes more towards the tail end. So, the cells are releasing themselves and going inside [the embryo] now. They're migrating in as individual cells, so they've gone from epithelia to mesenchyme and what they do is they form a new layer here. They

<sup>9</sup> Layer! Chickens 'lay' eggs! So, the word 'layer' is a word representing the source of something! So, a layer of cells is not just a static description of an epithelial layer, but it also encapsulates the presence of the potential for development and the formative principle within it.

<sup>10</sup> The primitive streak; the basement membrane is also being degraded at this point by digestive enzymes released by the cells.

have to free themselves, they have to transform themselves, they have to explore new possibilities and become new cells. They break away and they move in to first of all form a layer called the endoderm, which is the layer that contributes towards all our internal organs - the guts, the lungs etc. So, that's the first wave of cells that comes through and forms this endoderm layer. So, they migrate away as individual cells and then they clump together again as epithelium to form endoderm. And the next wave that comes through forms the middle layer, which is the mesoderm, which forms all the bones, all the muscle.

Brian: So, this is the self-othering.

Mike: This is the self-othering, exactly, yes.

Sindhu: So, all of this is happening in the blastula?

Mike: Well, this is now the gastrula. A chicken hatches after 21 days [of incubation] and this is all happening after only one day [of incubation], so it's very fast. But it's amazing to watch these cells migrate. You cannot help it, as an embryologist, to sit at the microscope and feel complete awe and wonder at how they're migrating. There is a feeling that there is a purpose, that there is something amazing and purposeful and meaningful happening here. It's not just cold objective science, from my point of view anyway - I never felt that way. But what this does is it sets up three layers and what is left at the top is ectoderm [which will form the skin and the nervous system].

This: I was wondering, and it's about terminology, but there was this thing 'infolding' from within itself, so the image that I have is of the incoming of three layers and then we have the closing that finishes that.

Mike: Yes, that's right, but it's a little bit later. It is an 'infolding'. It would be nice to show you a video of this to give you an appreciation of the dynamics of it. There's one of a sea urchin gastrulating. The cells come around and then they move in. This gets bigger, then it expands, then they break away and then they migrate inwards. It's this challenge to think in three dimensions and then in four dimensions and to spin things around in your mind. Embryologists do this kind of Goethean type science all the time because they're always imagining new possibilities and new views! Is that enough? How are we doing for time? 11:12, OK that's good. So, has anyone got any more thoughts on that right now?

Ole: In the end, these tissues are not connected any more, so there are three layers. It looks like they are turning inwards and creating a layer, but they form a layer in itself.

Mike: Well, so this is the problem. Ole's just asking about the different layers and if they're separate from each other. But, of course, they're not. You can distinguish layers because under the microscope you can do nifty tricks with light that mean you can see the different forms of the cells,

but the embryo is a whole, just as you are a whole. Mechanistic medicine would say, well, your liver is separate from your kidney and they're both separate from your skin, but there are many integrative medical approaches that look at it as whole. This is always the problem with teaching this stuff - we'll blame it on the Germans [tongue in cheek to Ole, Jörn and Lea], but this is the problem with the naming that goes on. Because, of course, there's no such thing as mesoderm! It's just a phase, a process in time, in which these cells behave in a certain way.

### **Dynamics of distinguishing and relating**

Jörn: It reminds me of this unitary band of distinguishing and relating that Bortoft talks about. It's like as soon as you fix it in terms then it is seen as this one thing, this one event.

Mike: So, embryology turned into developmental biology and, because of the gene-centric view of the world, what developmental biology became was a fixing of tissues at certain stages in order to examine snapshots in time of gene expression patterns. Does that make sense? So, you can produce some beautiful works of art actually by fixing and staining tissues and looking at the way particular genes are expressed in certain tissues at certain times. And I've personally loved doing that. I remember the first time I got a new expression pattern for a protein I was studying, it was really exciting. But the problem is that as soon as you fix the tissue. and we can go back to that first session the other day - we can go back to Hooke and fixing tissue and using a microscope. Yes, you get a different view of reality at a different level - people hadn't seen those drawings before, they hadn't seen the world in that much detail, at that level and they didn't believe him in some cases. But, what's happened more recently, because of developments in microscopy, is that you can label individual proteins with, for example, a green fluorescent dye, and you don't have to kill the cells.

So, for example, with a transparent zebrafish embryo you can label a specific cell and then put it under a microscope and then you can see when and where that protein is expressed in different places at different times and you can follow it in real time. It's mind blowing what can be done now. But what it's doing is giving us a much better perspective on processes in embryo development. Embryologists have always been extremely good at going from this static view of the world, which of course our reductionist analytical mind has to be able to do in order to see these individual static stages of development. That gives us something to hold onto in terms of our ability to comprehend it. But the new technology allows us to see the processes much more clearly and obviously there are so many genes that are known, so many networks of genes. I've only mentioned cell adhesion molecules, but there are literally thousands of genes that are involved in all of this.

Jörn: Transforming itself to find itself! So, it's a journey! It's a unitary event.....along a path.

Thais: It's even amazing how the cell.....even if we go to the gene, the gene has its structure, but it's all like a bundle and messy, so how does it know where to go, what path to take?

Titiane; Yesterday we talked about a directing agent in the embryo, so what was that?

## Creating the path in time

Mike: So, it's almost like sometimes particular cells want to go and migrate off in particular directions and what they will do is to produce their own road, their own path! So, there are molecules that they can produce that actually produce the road as they migrate. So, there are a bunch of cells that come from the nervous system [the neural crest cells]. They migrate out from the neural tube, from the spinal cord as it closes. What they do is produce specific extracellular matrix molecules that enable or allow those specific cells to migrate along. Again, it is a balance between having the right protein, which isn't too slippery or sticky, and producing the right amount of it so that the cell can make good progress, so that it can go out and explore and find itself without staying stuck.

Thais: So, it's kind of like how ants find their way.

Mike: The ants, if you think about it, we think about our bodies as discrete systems - that is as complete wholes and we have our own self-agency, but also cells in your body also have that self-agency, particularly during development, and so it's no good if your cells suddenly decide they want to go off on a journey as an adult. Well, that's no good - you end up with cancer. So, this balance between transformation and stasis is really the interesting balance, certainly in embryo development. There are all sorts of issues to do with timing here as well. So, like yesterday [during the card puzzle] you said about how the timing wasn't right to start putting the cards down [to reveal the whole story]. Well, it's the same as the cells in the embryo because they have to wait for the time to be right before they can express themselves in certain ways to become certain tissues or certain other kinds of cells.

Alex: Who was it I was talking to yesterday about the Greek concept of kairos, a second type of time? This beautiful concept of chronological time - chronos and then we have qualitative time, which is kairos. And Aristotle referred to kairos as the supreme moment in time, the opportune moment in which what he called 'the proof' is given, which is quite perfect. I love that! Which brings us back to Philip's idea and Goethe's idea of the mathematical proof and Craig and the non-discursive moment in time, when it is time to act.

Mike: Exactly! And cells know that intuitively, intrinsically! They know when to do the right thing! I wish I could remember that poem about when the time is right to jump!

[Here is the poem]

*"Come to the edge, he said.  
We are afraid, they said.  
Come to the edge, he said.  
They came to the edge,  
He pushed them and they flew.*

Come to the edge, Life said.  
They said: We are afraid.  
Come to the edge, Life said.  
They came.  
It pushed them... And they flew.”  
— Christopher Logue

So, a lot of embryologists through the years have spent quite a lot of 'time' coming up with what embryos look like at certain times, but that's this sort of outward instrumental view of time. So, you're imposing time on the system, whereas the cells within the embryo have a completely different concept of time, which has to do with: when is it right to make a decision to become something different? ['Lightbulb moment' sounds from the students here!] There's no point in a kind of rebellious, revolutionary mesoderm cell going "I think we should all become neurons". But scientists can take a mesoderm cell out and we can transfect it with certain genes and proteins and we can push it towards being a neuron, but that's not what normally happens. That's this kind of artificial pushing from the outside - putting nature on the rack as Bacon said.<sup>11</sup>

### Death as creative transformation

Thais: And we didn't even go into the cell quality check because it has self-monitoring systems, so if something doesn't work it will go into suicide.

Mike: So, death is an intrinsic part of life in embryo development. So, 80% of all the neurons, which were ever in your brain during development have been killed off and the other one which is interesting is...has anyone ever had a thought about why duck's feet and chicken's feet are different from each other?

?: Swimming?

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<sup>11</sup> See: <http://www.thesouloftheworld.com/the-new-experiment-putting-nature-on-the-rack/>

*"Bacon insists that the mechanical experiments of the new philosophy must approach nature "under constraint and vexed; that is to say, when by art and the hand of man she is forced out of her natural state, and squeezed and moulded." Through experimentation it will be possible to trick nature into confessing things that she might not under less strenuous testing. But once her secret is out, she can be forced to reveal it again and again. Thus Bacon explains that the scientific researcher needs to "follow and as it were hound nature in her wanderings, and you will be able, when you like, to lead and drive her afterwards to the same place again." Through such experimentation, mankind will be able "to penetrate further," pass beyond "the outer courts of nature," and "find a way at length into her inner chambers." Extract from: Restoring the Soul of the World: Our Living Bond with Nature's Intelligence by David Fideler, 2014*

Mike: Yes, so ducks swim, chickens don't (unless you've got a rebel chicken). Ducks have got webbed feet right? The reason is that, initially, all limbs begin as a paddle shape. It's not like the digits grow outwards - there's a paddle shape and the cells between the digits die in a 'programmed' cell death.

Thais: There are people born like that.

Mike: There are yes, and Gollum in lord of the Rings had webbed feet, so obviously his cell death mechanisms weren't as good! He was a hobbit originally wasn't he? The point is that cell death is necessary. It's like a sculpture, but it's like the sculptor is inside the embryo, it's forming itself, it's being created as it goes. It's a creative process in my view. It's a creative exploration of all possibilities for form. Again, we have this Neo-Darwinist view of evolution, which is very much focused on random mutation of genes and natural selection, but there are other views of evolution in terms of changes in form and self-organisation, resulting in different expressions of form that may or may not be suitable to that particular environment at that time.

Jörn: What came to my mind, with this death being intrinsic to life, is that as soon as transformation is required, as soon as cells move to other stages, it is a leaving behind of old possibilities, of letting old possibilities die to embrace new possibilities. So, death can become or [be a] wanting to emerge. So, there is this ebb and flow between Being and Acting and between stasis and transformation, where, in times of stasis, we are with what we are or who we are, but as transformation knocks on the door, it says leave something old behind to embrace the new.

Mike: Exactly! Very well put!

Fabio: What is that when you're a protein though? [laughter]

### Expressing differently

Mike: Well, so a good example of that actually is - I worked for a long time on eye development on the lens of the eye. There are proteins in the lens of the eye called crystallins and these are usually metabolic enzymes that pack together very closely and form this transparent structure, which is literally an optic lens and yet they are all metabolic enzymes. So, lactate dehydrogenase is chicken delta crystallin. So, maybe that protein is having a different experience depending on whether it's a metabolic enzyme catalysing a reaction in a cell or whether it's sitting there in a lens doing a completely different job. Now maybe I'm being facetious, but the point is that the same protein (in terms of its amino acid sequence) is having a completely different experience depending on where it is expressed.

We've got 30,000 genes, which is not very different to a fruit fly. Does that make you feel good? But it's what we do with the genes. We have a much greater ability to process them and assemble them in different ways and then individual proteins can be present in different places to do different jobs. They're individual parts, but they're fulfilling a different role in the whole all the time. As Philip says,

the whole is self differencing in the parts, but the parts are journeying to the whole in the embryo. At every single point, every single time that cell divides and it does its self check, there is an opportunity for creativity, [for it] to become something different, but within the confines of the structures.

### **Creative communication, boundaries and health**

We run into this issue of chaos and complexity and where the creative change is. In terms of evolution, the creative change is on the edge of chaos. So, it's that ability for those cells to be in a place where they aren't overwhelmed with chaos, which can happen sometimes, if a cell is stressed too much. If we get stressed, it doesn't do us any good. But, if we can maintain that balance of being in that creative zone, then all our cells are going to be nice and healthy and development is going to just proceed and we're [also] going to develop. And that was the nice thing about the card game yesterday - you individual cells all contributed to that whole without anybody getting particularly stressed about it. There was a lot of healthy communication, which is what needs to go on with these cells.

Thais: Just a reflection on that. Because the cell knows its time and the animals have that thing where they step away from the pack. And in humans it has got so much more complicated. Some people know when it's ending and they know when it's coming and they talk about it and some people will just...it's like we're so disconnected from what's going on inside that we don't notice.

Mike: Absolutely right. So, in terms of the cell in an embryo or in a body, the cell has to have an amazing ability to understand its own internal state perfectly, but it also has to reach out into the world around it and appreciate the environment that it's in - all the inter-relationships, all the other cells that it's with. The cell that's next to me might be the one that's going to become a neuron and I'm going to remain an ectoderm cell [and become a skin cell]. But, I have to be aware of that change in the external environment, so not only is it about thinking about parts and wholes, but also internal states and external states, so inner arcs of attention and outer arcs of attention. This balance between the two. The cell membrane, with all the proteins that are in it is that boundary, is that liminal place. So, you guys might like Bruce Lipton's stuff.

Evelyn: He was here recently.

Mike: Did you meet him? I met him briefly once [in Dublin]; he signed my book. But he says, and maybe we'll end on this because it's time for tea, he says that everyone talks about the DNA as being the be all and end all of the cell, but the DNA is just the gonads of the cell! The cell membrane is where all the action is, that's where the 'brain' is, that's the boundary between the inside and the outside of the cell, just as our skin is our boundary, but it's very permeable - that's the point, just as a cell membrane is.

OK, I hope that wasn't too complicated.

Evelyn: You took us to many places.

Mike: Too many maybe!

## Chapter 6

### Rhythms of unfolding

A minute's silence.

#### Introduction

Philip: What it feels like to me is a bit like that game we were playing yesterday. We are looking at the cards. First we described some complexity cards, which was how do volatile systems with patterns of relationship arrive at form. We looked at those cards. Mike has given us some biology cards. He is describing biology. And I am going to give you some physics cards. And we are going to try and make meaning out of all this. And even more exciting than the game yesterday is that we don't even know there is a meaning.

Just now, we were looking at the end of the rooster [the last card in the zoom game], in fact we went to the embryo of the rooster (chick). And now we are going to make a small shift and go to the other side, the empty space, the cosmos [the first card]. How can the cosmos be linked to the rooster and the embryo?

Phrases 'as above, so below' and 'is the universe an organism' suggest that the understanding of one level, is applicable to another level. So can we get clues when we look at outer space, to the level of the rooster and life?

We are going to set off on quite a different journey. My cards that I am looking at are the development of physics. We started in Chapter 1 with Leibniz and Newton, then we met Maxwell and fields in chapter 3 and now we get to Einstein.

#### Einstein

Einstein was working in a patent office. He was not working at the university. He had not liked his physics education. He said it was a wonder anyone did physics after being taught physics at school, it was so boring. He didn't get a job at the university. He had to get a job at the patent office.

And in one year, 1905, he completely transformed all of modern physics. He wrote four papers that laid the foundation of relativity and quantum theory. He completely transformed physics, working in his spare time. People would assume that he was working at the university in Bern the place name which appeared with his signature under the papers. So they would send letters to Einstein there.

But the university had never heard of Einstein. For he wasn't at the university, he was working in this patent office.

Einstein transformed the notion of how we understand happening, how we understand event. It is not too dissimilar to where we were this morning, but of course this is physics, so on a completely different scale.

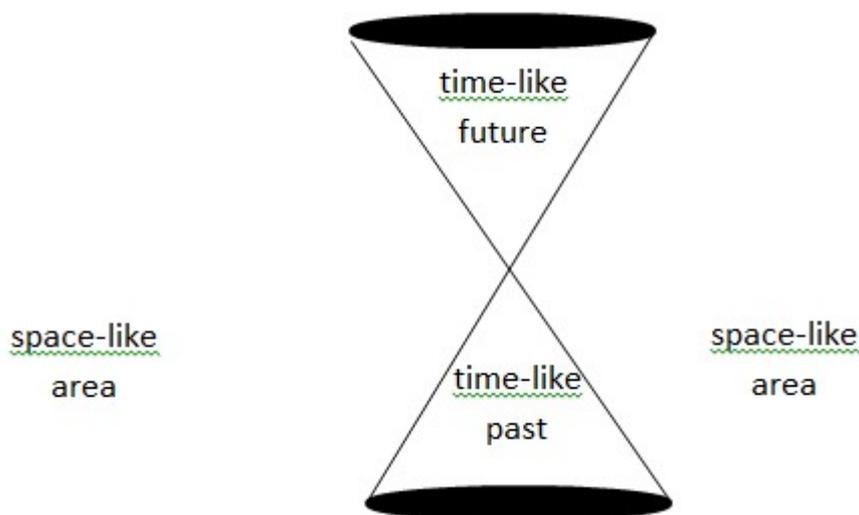
Newton had basically said there was absolute space. So if you look at these cards depicting the embryo development of the zebrafish, then this snapshot here is one event in absolute space, at a specific time, which we could label  $t_1$ . The second card is at time  $t_2$ , the third card at time  $t_3$ . Reality is found in space. The reality science is looking at with Newton is matter in space. The puzzle is to find those physical laws, which absolutely determine how  $t_1$  develops to  $t_2$ , and  $t_2$  comes to  $t_3$ .

Time in Newton's view of existence, is just a passive container, and all it does is that the physical laws of matter, transform time  $t_1$  into time  $t_2$  and  $t_2$  into time  $t_3$ . That is what modern biology is looking for. What are those absolute physical laws, by which a collection of genes and proteins at  $t_1$  automatically by their very nature, not with any intention, not with any foresight, not with any intrinsic value, arrive through these physical laws at the stages,  $t_2$ ,  $t_3$ , etc. Time is just a linear background progression, which automatically draws a collection of material cells from one point to another.

### Special relativity

Einstein was not really happy with Newton's idea of space and time. He came up with a different view of how to imagine event. It had to do with light. We saw from Maxwell already that light is this special thing. It is always travelling at this same huge speed of 300,000 km/sec. Einstein said let us not start with space, let us start with light.

He imagined that space and time were not defined as the container of existence. The definer of existence was light. Light was where you began and from there you deduced time and space with relation to the light cone. A time-like area and a space like part were described with relation to the light cone.



I say space-like and time-like, for given that light has a constant value, space and time could appear differently to different observers who were moving with different speeds. Einstein said there is no absolute space, and absolute time, there is always space-time. Space-time are always connected in their relation to light. You cannot understand the space of this thing, separate from the time of its development. Space and time are always linked. And after all why should we say space, where matter is, should have a priority over time, when they are both equally essential in forming this pattern of what is there at the present. Einstein said you have always got to consider space and time together, and joined by light.

Brenda: What did you write on the board?

Philip: The light cone has a time like future, time-like past and space-like around. So when you are at the centre, light defines you in relation to everything that can happen. Objects between which light communicates, me and the tree, for instance, are space-like relationships. Everything above the speed of light is a time-like connection. So light is the boundary between space-like and time-like. But space-like and time-like are not different from each other. They are simply separated by light into these two areas.

### Constancy of light

Say I am on a train going at fifty miles an hour, and send out a signal at the speed of light. And there is someone on a train platform, as the train passes. Normally if the train is travelling at fifty miles an hour and the person on the train sends out a signal at the speed of light, the platform person would see light travel at the speed of the train plus the speed of light. Velocities are additive.

But Einstein said for every observer, they see exactly the same speed of light, no matter what their relative velocity. Light always has the same speed. So the person on the platform sees light travel with the same speed as the person on the train. That seems paradoxical. But Einstein says the reason is that this person on the platform has a different interpretation of space and time than that of the person on the train. Space and time are no longer absolute. The person on the platform might see two events happening at the same time and the person on the train might see one event happening before the other event. In order to start with the speed of light as that which is absolute, then space and time become different for different observers. Space and time lose their absolute quality.

As an example, over the journey of the embryo we have been looking at through the cards, what is important is that space and time arrive at something coherent. It is not important exactly what happens in space, and what exactly happens in time. What is important is this journey over the whole that realises itself, that completes itself.

Light has this quality of being right at the centre of the universe in Einstein's equations. David Grandy writes about light:

‘As a presenting medium, however, light does not yield to such experience. To bring off vision of other things, light must be “the ‘letting-appear’ that does not itself appear.” It must also be the “letting appear” that gives rise to visual experiences not spatially and temporally coincidental with the things experienced. In letting all this appear or happen, light is not party to any of it. Its lack of appearance, its clearness or invisibility, keeps it fully present rather than imaginistically divided off into places we call “there” and “then.”’ (*Grandy, p.56-57*)

To bring off vision of the chestnut tree, light brings us the tree which is distant from us. So light is somehow able to let the tree appear to us. We do not see the light, light brings us the tree. We never see light itself, but light allows us to see the world.

Brian: Is that true you never see actual light?

Philip: Light is unseparated, like wholeness. If you travelled on a beam of light, there would be no separation, there would just be wholeness. Light is like the wholeness we are talking about. It is the wholeness that gives rise to the separation. Space and time have meaning in the way they relate to light as wholeness.

Karina: You know what this reminds me, enlightenment, when masters come to this thing of wholeness.

When wholeness comes into the cell, there is light.

Karina: We are all enlightened

There are different perspectives of the separable or non-separable.

Henri Bortoft writes: ‘It is a consequence of the universal constancy of the measured speed of light that light itself is not subject to the space-time separation which is characteristic of material bodies. Light itself is before separation, and it is a consequence of the null-interval that the universe for light is an intensive point including all within itself. To the logic of solid bodies, for which separability is a defining characteristic, such non-separability is highly paradoxical to put it mildly. But now imagine a being of light. For such a light-being the world of bodies would be impossible to imagine, and the idea of separability would be highly paradoxical. So if we say that the behaviour of light is paradoxical, we should not imagine that this paradoxicality is somehow intrinsic to light itself. Non-separability, in whatever form it takes, will always seem paradoxical to us in the world of bodies where separability is the major characteristic.’ (*Bortoft, 2010 p. 34*)

That was Henri writing in the Holistic Science Journal. I had written to Henri inviting him to come to a conference on paradox. He replied I cannot come, but attached a 4 page essay on paradox. That was how the Holistic Science Journal started. We needed a journal to put the article in.

Mike: Cause and effect.

So what Einstein does is incredible. He inverts the perspective of Newton that you could look at matter as just separateness on its own. Einstein says that we only understand separateness when we see it through wholeness.

Alex: I realise that is perfect, when we see it through wholeness.

And light is the messenger of this interaction.

*[Alex chokes on his toast]*

Alex: Can you repeat the line (munch, munch) we only see separation.

Sindu: If you want to see the whole through the parts, then you can only see the parts through the whole, so there is no separation there.

Philip: Henri was saying that both these perspectives are active at the same time. There is the separable world and the inseparable world. They are both active at the same time. From the perspective of light, you are seeing the non-separable world. And from the perspective of matter, you are seeing the separable world. But actually to have a proper theory of how something happens, you need to have both perspectives simultaneously.

We can see there is the non-separable impulse moving through the stages of the embryo, but also there is the separation, there is biology, we can identify the endoderm, the mesoderm, the "other derm"

Mike: 'Its behind you!' [like the audience at a pantomime pointing out where the baddie is!]

Isa: And then we have the meaning

Philip: The inseparable is the meaning in which all the parts are moving to this one place of coherence. There are always these two aspects, of inseparable and separation.

We do not understand space and time, by looking at the parts as separate and then trying to get to meaning. But through light, we understand where the world of separation comes from and how it takes on its characteristics. These are two dimensions of existence.

It is not to say that we cannot analyse all the stages of the embryo, and separate and put labels on each different activity and differentiate phases with particular meaning. Separation is a world unto itself. It is a dimension that allows us to completely identify, verify and test what is happening. And yet somehow when we only do that, we are not getting at what is really happening. What is really happening is not in that world of separation. It is in the way the inseparable comes into being through those separate parts.

Isa: Is this not all the result of our brain division, seeing things as duality.

Philip: There is a very good book *The Master and His Emissary* by Iain McGilchrist on just that connection.

### What is the whole story in the cards?

Brenda: I am still struggling with the example of the train. Is there a single experience that is the same for the person on the train and the person on the platform?

The same thing is happening but the two people are seeing it differently. This has been tested. If you put a clock on a rocket that orbits around the earth, and that rocket lands back at the same place, then the clock will have gone slower than a clock sitting on the earth. In travelling, there is a different time, relative to the time of someone at rest on the earth. It is not to say that it is an inconsistent world.

[laughter]

Einstein's theory has been tested again and again.

It seems at first weird that if you give up space and time as definitions, surely the world falls apart. But actually it doesn't. It is not necessary that everybody measures what is happening exactly as the same space and time. What is important is that the journey as a whole completes. And people can have different perspectives of time. A seed in the ground can stay for years in its original form.

Development does not need an exact space and time. That is a concept that is not really helpful. When we try and dissect the embryo, it is good for our mind to say "there is this stage, then this, then this." But when you think about it, it does not really help us understand the process of embryonic development. In fact it is hindering us. What is helping us understand the process, are these coincidences where the development moves between different recognisable stages of activity.

At this point where the embryo is doing something different, where space and time are going into a different organisational dance, that is what we need to understand: the rhythm of how this happens, then the rhythm of how the next stage happens, then the rhythm of going inward happens. Space and time are actually getting in the way.

For instance, when doing Goethean science last year, the process of getting to know the plant was hindered by the showing of time-lapsed videos of the plant. Once one sees the plant speeded up in time, the students can no longer understand the rhythm that is the pattern from which space and time arise. It is not something, like "wow, isn't the plant magnificent, it goes like this." The rhythm is extending in space, and its pattern is manifesting in time. It is a vital thing that space and time are not outside that process. Space and time are in that process.

Ole: Life without rhythm wouldn't exist, There is so much rhythm in everything, in every living journey.

### Rhythm of the living journey

We understand space and time through the journey of the whole. Only then, at the end, does it have a meaning. And it doesn't matter what our watch says, or what the metre rule says. All we are asking is how do these patterns of development reveal themselves as space and time afterwards. But the pattern forming is the source. We could equally mark time and space in another way. Any pattern that allows division is what space is. Any pattern that allows duration is what time is. Because this pattern has division and development within it, we know space and time from it.

It is not that zebra fish development takes three days, but as from an ancient viewpoint, three days is the zebra fish embryo. The measuring of it gets in the way of this understanding. The pattern is in both space and time. The embryo is dividing and becoming together. And when we separate space and time, we think we have to understand one stage, and then understand what is changing between the stages, rather than saying let us understand this whole journey and then we know space and time collectively.

Fabio: It is hard to break free from that thinking. If you were travelling at the speed of light, the zebra fish embryo would take years to develop.

Philip: If you were travelling at the speed of light, it would be instantaneous. There is no separation, so you would just see the beginning and the end as contemporary forms. You would only see the wholeness of the transformation.

Fabio: Intensive point.

Philip: We, at our finite speed, see the process of the whole as it happens through space and time.

Fabio It is always very confusing.

Philip: You always have to ask, time in relation to what? The chestnut tree has its own vision of time. It is much slower than our vision of time. Its time is found in the rhythm of how it forms a new leaf, how it forms a branch, newly out of itself. And us humans it must think what are we doing rushing around all the time, feeding ourselves, then having lectures. The tree's time is much slower. Its time is the pattern of its growing, from branch to leaves back to new branch. That rhythm is its time. That is how it extends, so it is its space too. That is how it makes a boundary in space.

Evelyn: Space and time are a tree or each person coming into form in its own rhythm. If we took away the clocks and the measuring tapes we would still have the concepts of time, space.

### Coincidences

Einstein said from now on, space and time as separate things have no meaning and all we can consider are meaningful coincidences. Where we transform from one state to another, that is all space and time are, coincidences. So in this embryonic development, there are various coincidences we can focus on. But see the difference, when we look for coincidences where things are changing

as a basis to describe space and time. We are looking in a different way. We are looking through the process. What are the critical points, at which the development starts doing something else.

Mike: Can I ask something about calculus with regard to this? The cards represent arbitrary snapshots. But in order to really understand this process, you would actually have to take an infinite number of snapshots of the whole process, in an eternal amount of time. So I am thinking that in relation to development and evolution, we have this linear view of evolution. If you were to study every single possible stage, you would have an infinite number of snapshots.

Philip: Einstein says that the only reason we can examine this process in space and time, is that it completes a whole over its journey. Relative to that whole, these stages have meaning, so we can see a finite number of meanings develop in relation to that whole. But if there is no whole, then the process is infinitely separable. If there is only separation, then you can ask "what happens between this and this? What happens between that and that?" You do not have a reference. You can keep separating and separating and separating, which is what science is doing, coming up with more and more names. But you do not have the reference of the whole.

Brenda: Mike what you are saying is that between every two cards there you would have a micro circle of happenings.

### General relativity

Philip: Now we have done the special theory of relativity, which is pretty good. Now let us go to the general theory of relativity.

Thais: Why people spend so long studying these things...?

Philip: Because they do not have the whole. Today we have done most of biology and physics.

*[laughter]*

Philip: When you have the whole as reference, then you do not have to go into all the detail, you just have to ask what is the pattern that realises the whole. So we could do Harvard education in three hours.

Brian: When we begin with the meaning we go much further.

Philip: Yes, because you are not lost in the matter. So the next thing Einstein did....

Brian: We are going to graduate soon.

Jörn: Thirty years of normal studies

Philip: So Einstein said we want to look at the world through space-time together. We are not separating them anymore. We want this space-time to have a constant speed of light. We want to see what is the relation between space-time and matter? Einstein begins with nothing, a freedom

where everything is possible. If we can have any form we like of space time, with one condition the speed of light is constant, then what can we learn mathematically, about the shape of the universe. Nothing is defined, everything is free to happen, except space and time are together, and the speed of light is constant.

And what happens is that Einstein comes up with this unique solution, defining a grid of that *wanting to born though itself*, the field of gravitation. Where there is matter like the sun, it bends space and time, so the earth is slightly falling into the sun in the earth's trajectory through space and time, and this corresponds exactly to our experience of gravity. Why is the sun attracting the earth, when they are miles apart? Einstein said that there is one uniquely consistent solution, that space and time are indented by matter as the sun, so things near the sun are defined in their space time as if falling into the sun. Space and time are specifically defined because of our relation to matter. Space-time definition corresponds exactly to the way we experience gravity. Einstein's theory was shown to improve on Newton's theory of gravity.

Thais: I can see gravity affecting space, but not time.

Philip: You have to forget about time separately, and deduce space-time from the rhythm of happening between parts and whole. Wherever you have energy, you are changing the pattern of space and time. So energy and space and time are linked. So where you have got a lot of energy, this process is going to be happening quicker. If you had a little energy, this process might not finish, but it would have a different quality to it. Energy, space and time are coming together as if there is some pattern between them.

Einstein showed there is one single relationship between energy and space and time. He comes up with one equation which shows a primal pattern. Matter shapes space and time and that tells matter (and light) how to move. So there is one formula for the universe, for matter. The Big Bang, the evolution of the dynamic universe, all comes from Einstein. The universe too is organic. This arose from Einstein's work.

What we are learning is that energy, space and time are not only the features that determine this process of the embryonic development of the zebra fish, but it is also what determines the universe. This dance between space, time and energy. You do not have to worry about the detail, but there is this elemental dance, between space time and energy with light as the constancy.

### **The black hole**

The first person to test this relation of space time and matter was Sir Arthur Eddington. Einstein finished his theory in 1915. At the end of the First World War, Eddington mounted this expedition to look at light from a star that was situated close to the line of the sun, but which was to be visible due to an eclipse of the sun.

As predicted the light from the star was shown to be deflected by the sun. Eddington showed that where you would expect a star to be, was bent slightly by its closeness to the sun. The trajectory of light was bent by matter. This proved Einstein's relativity and made him a hero overnight.

Einstein was very worried about a consequence of relativity he could not fathom. Where there was a huge concentration of matter, then the indentation of space time becomes so pronounced, that the bending of light from its normal trajectory becomes so off kilter from how it normally is, so deviated that it cannot any more escape from this region. And this was called a black hole. Everything switches around. Space becomes time-like and time space-like.

*[laughter]*

*Once you have crossed this boundary you inevitably fall to the centre. The pull to the centre increases, taking all mass in to this one singularity.*

Eddington had an Indian student Chandrasekhar who worked out that these black holes could actually exist. When a star of a certain size burnt away all its nuclear fuel, its matter would get denser and denser and it would form one of these black holes. Eddington in a lecture at the Royal Society publicly ridiculed Chandrasekhar, for his conjecture that matter could just disappear down a singularity. And this put down dismissed Chandrasekhar and his paper, until thirty years later when he won the Nobel Prize for it. And now we have found every galaxy is known to have one of these black holes. You can deduce the black hole from its influence on the matter around.

Karina: What happens when you enter a black hole?

So, the first thing is that all the order disappears down a black hole. You inevitably arrive at the singularity. Everything that is ordered goes, including space and time. So what is that point of nothingness? That point of nothingness is not the end. Amazingly, there is a quality that from this black hole of disintegration, a white hole of creation has to re-emerge, as a kind of new story that is coming out of this destruction. *(One could say that matter is the continuity, in which space time event is patterned to concentrate in towards an experience beyond space-time that generates a new region of separation.)*

## **Embryo**

Philip: Now let us return to the journey of the embryo. At the midway point of the embryo development is a name tag with my name.

*[Somehow a paper tag I was supposed to be wearing with my name on, the day before had fallen off. It had appeared in the morning on the floor as we were laying out the cards, at a particular significant point half way around the embryo journey. It had been left in place. It is to this name tag I now refer, as it marks a significant place in the journey.]*

If you look at the first part of the journey, the cell up to this point is taking a huge risk. It is destroying its old order. It was a cell, that had a certain identity, had a certain behaviour and had a

certain way of doing things. As it goes on its journey it is destroying that order, but it is not yet viable in its new order. It has to travel all this way to the point where "Philip" is. It has to go all this way to create this platform in which the whole new being can come in. That point is a crucial point. It has to get rid of all its old order. You can imagine its mother cell would say "What are you doing, you were a cell at the beginning, completely viable, you had good prospects, you were going to be a lawyer, and now you have formed that stupid thing." You would say "But mum I am going towards a zebra fish embryo." "Don't be stupid." As everybody knows, any journey has to go through this singularity before it can come out as creation.

We imagine that the universe is about the Big Bang as the story of creation. But there is another way of looking at this, letting the whole in as a formative influence. We have to go on a journey, where we allow that whole quality of life, that whole weighing of the universe to come in, into a new expression.

The field is a relationship between matter, space and time. Time is drawn into a behaviour which experiences matter as a gravitational pull on event to reveal the unity essence in light beyond the separation of space and time. This mass is the continuity that drives space and time to come together into the wholeness beyond space and time. It can be that this cell starts on this journey, and that this energy comes from the influence of the introduction of the whole into the parts. The introduction of the whole gives energy. As when you are travelling, at a given point, exactly the energy you need to meet your goal comes in. So you could say that the cell goes into this journey to wholeness, and borrows this energy of the whole which lets it express itself out into this fully developed form, when it uses up that energy and becomes something fulfilled. Instead of thinking the matter is there beforehand and we are in a world of matter, the matter arises in this dance of destruction and creation. The universe is too this totally organic thing.

Mike: That really fits with this, because this ball here is not part of the embryo, it is yoke sack that is pure energy that the embryo is going to use to create itself. Because once it arrives, that ball of energy is actually gone. The first cell sits on top of the yoke sack. The yoke is deposited by the mother, when the egg is laid. It is an analogy with what you are saying, the yoke is energy for the development to be completed.

Fabio: So you think the cosmos is an expression of this initial energy.

Philip: Instead of the energy of the cosmos always being there from the time of the Big Bang and becoming disordered into the parts of galaxies, you could say that each galaxy, each cosmic body, is actually a process like the embryo, in which it is borrowing energy to express something of the whole. When you have an experience of wholeness, you also have the feeling that something is left inside you, like a seed, and it can be years before that seed knows what to do with itself. The seed is giving you the capability to fully develop into the expression of the whole, which is what drove you on that journey in the first place.

When you look at the field idea through the eye of meaning, the two reflecting surfaces of the whole and the part, this reflective double mirror, which is isolated from what is around it, for light is captured, so it is not interacting with what is around it, but allows this process of disintegration, going into a singularity, and renewal, expression, to take place. When we look through meaning and we don't start with matter, when there is a process of the parts making meaning from the visitation of the whole, the matter does not have to be there before. The matter can be part of the process. The whole and the part energise each other in the reflection of their possibilities. The energy is just sufficient for the pattern to fulfil itself. So we need energy to drive patterns, from which we know space and time.

We have now turned science completely on its head. We started with space of Newton, matter being what fills space. We have ended with we need the energy to drive processes that reveal space and time in the patterns by which wholeness and meaning become.

Thais: Could we do the whole thing again?

### Transition

As another example, the whole process of differentiation, involves a separation from its own context, it has to leave behind its old order. This thing could have existed in its old order as just a cell, it does not have to go on this journey. But once it has decided to go on this journey, it has to destroy its old order, its old place, its old existence. And that destruction continues, it gets more and more differently shaped, until at a given point, [the point marked by "Philip"] it starts actually picking up this new order, it starts actively moving towards the creation of this new unity, this new thing that is going to be born in the world. We can understand this event. Instead of thinking as matter here and matter there and matter in the egg, instead of thinking of matter as separate to the process, we see the energy is arising from how the wholeness is coming into the parts.

Isa: are you aware that this process operates in us, in ourselves, each of us are comping into the moment that we have to leave the old behind, bringing the new us?

Mike: In embryology, we always refer to a point of commitment in which the cell is committed to a particular lineage. The bifurcation point is a particular commitment.

Thais: how does the light go into the black hole?

Philip: The earth has enough speed so that it does not fall into the sun, it can go round and round the rim of that depression. But imagine if the sun gets so dense that even light if it was passing near the black hole, would spiral into the black hole, it would fall into the black hole. Everything ends up falling into it. The light cannot get out any more.

Eddington was looking at a black hole and realised that the only way to describe a black hole is to fall into one. You have to experience destruction and creation. There is no standpoint of someone standing outside and telling the story of it.

Jörn: Following on from 'As above so below', this is the experience of our own lives, we enter a black hole all the time, we realise that the hero's journey is going into the black hole and committing to the new identity, committing to our unique place here on earth, so we realise what is like going into the black hole and so we can understand the cosmos.

The universe is weighed. The cell has a quality of the whole universe. It is weighed in the whole possibility of the universe. It is not just matter that is forming any old thing.

Mike: There is a way, a path.

Karina: How did you get to the idea that the cell is committed to transformation, at the "Philip" point.

Mike: Every single cell becomes committed to be something different but there is a concept of stem cells, which can become anything. During the growth and the division there will be specific bifurcation points, at which the cell will go in a certain direction and become a neuron or a mesoderm cell, and at that point the cell is committed to its destiny. This is a point of no return. There are specific points of commitment in natural growth that the cell cannot go back.

Karina: We shouldn't be scared of transforming into something different

Mike: The changes arise naturally when the time is right.

Philip: We tend to look outside us for creation, but creation is already there.

Ole: Actually there is no structure in the black hole, there is all possibility, it is actually an infinite potential. There is no structure but also all structure. When we in our lives come to these turning points where suddenly everything falls apart, suddenly everything is possible.

Jörn: How are we going to create something new?

[Profound silence]

Karina: What a nice class

Philip: It is like the game of yesterday telling the different pictures on the cards and finding they tell one story.

# Day 4: Thursday

## Chapter 7

### Questions determining Existence

#### Reflections

Philip: Any reflections on yesterday?

Brenda: I feel it is a little bit like when Picasso started painting cubist paintings, a new way of expressing something very beautiful, a little bit impossible, and at the same time totally making sense.

Mike: Picasso came up with those ideas 1908-1912 at the same time.

Philip: Same time as quantum theory, which we are going to look at today.

Evelyn: What we did yesterday gave me a big insight of one aspect of my life in Africa. I often did fieldwork, I would be driving, go where I would be doing fieldwork, and then pack up and head back. We never rushed. Someone had invited me on this particular trip to stop and have coffee. We were travelling back and I said to Boyd my colleague "Oh I have a phone signal now maybe I should ring back to the base, just phone ahead and tell when to expect us." My companion Boyd started laughing, "you white people are so funny, how do you know when we are going to arrive?" "What do you mean?" "This time thing." From that moment with the cards yesterday, what form are you going to arrive at, you only get your energy on the journey. It is another different relation to time. And it changed my whole understanding of my time in Africa. [Laughs].

Philip: Now you are laughing at it. You have to write to him "Got the joke."

Alex: Meaning matters. Where, when the absolute is expressed relatively, the relative is impressed absolutely.

Mike: I'd like to read you something by a scientist speaking about space and time. It is quite good, very succinct. Terrence Rudolf of Imperial College London. "We think space and time are important because that is the type of monkeys we are."

#### Introduction

Philip: Yesterday when we were looking at the cell, we began somewhere. We began with something. We began with a structure. And from there we tried to understand what was the journey of wholeness from the zygote to the zebra fish?

The question we ask today begins with no structure. For the question quantum theory asks is how does nothing get to the most elementary of things, the particle?

Good question.

So we have to rub out relativity from the board because this seems like a different question.

It is like asking “what is the shore of existence, at which nothing becomes something.”

This question was asked by scientists when around 1900 they started looking at atoms and their constituent elements of electrons and protons. There were two possibilities.

- 1) You could imagine that at the shore of existence, science would find the elemental material building blocks that underpinned the world. That is what science was hoping to find, for it was a materialistic inquiry. When you dug right down to the bottom, you would find little things of which everything was made. So that was one possibility. But as it turned out it was more subtle than that.
- 2) There existed a cloud of unknowing, within which were the possibilities of becoming something. You have this cloud of unknowing, in which you have wholeness containing all the possibilities. This undecided state of possibility persists until meeting something solid, as an object or somebody looking. Something in the world of structure, at the shore of existence, meets this cloud of unknowing or cloud of becoming. And in this cloud of becoming, where all the possibilities are entrained, when it meets a structure, this cloud comes into existence, and something specific resolves, a particle being measured.

In the first scenario what was expected is that science would get to the shore of existence, come to an abrupt end of these basic particle structures, and reach an understanding at which there would be nothing more to say. In scenario 2, the shore of existence is something a bit fuzzy. It is this possibility of becoming, like the waves breaking on the shore, that when they meet something solid, some structure in the world, then that possibility expresses itself as something –a particle, matter, energy. But before that, it is not anything except this possibility. The finite world is a possibility within wholeness.

*[Philip: Relativity transformed physics, by applying a story to see the true nature of happening, taking into account the lens of light through which events synchronise.*

*But quantum theory needed a story within physics, to account for the odd nature of elementary events. The story was now within the happening itself.*

*So everything we say about quantum theory is not the theory itself. The theory is the nature of the happening. The theory is a story inserted into the happening that gives a frame that allows an understanding to be taken from it.*

*The physics no longer stands outside the events. The physics is placed into the events, in order to give them comprehensibility.*

*In particular, the capacity for things to be describable emerges out of the calculation we insert as a preparatory step into an experimental setup before anything happens at all. The physics presupposes what comes to be measurable.*

*What is measurable is entangled or superposed or woven through all the possibilities for existence. But the more profound realisation is that somehow the question we are asking is the world we observe. The coherence of the world at a quantum or elementary particle level follows from the nature of the question that is asked of existence collectively as to what it is. Our logical inquiry is an active provocation to which the world responds with a certain order in consequence.*

*One can only understand this quantum reality by putting into the phenomena of experiment, the structure of the question, of which the world is the answer.*

*As an example of this, consider the first riddle which quantum theory grappled with.]*

### **Black body radiation**

Quantum theory began with an observation about the energy emitted from an isolated body (black body radiation) and transmitted to the environment.

As we remember from chapter 3 one of the understandings about electromagnetism, brought in by Maxwell, was that light was a natural product of the field. It was to do with a background radiative process of an oscillation between the electric and magnetic field components, and so was a universal wave phenomenon independent of any individual identity, or any internal perspective.

But the way a radiating body reacted with the environment, could not be explained on this basis. For one would expect, in the situation of a body radiating in equilibrium with the environment there should be an infinite number of frequencies available for it to express energy, and so all the energy of the body should transmit itself to the environment. The question was how was it that the field or the environment did not exhaust all the energy of bodies.

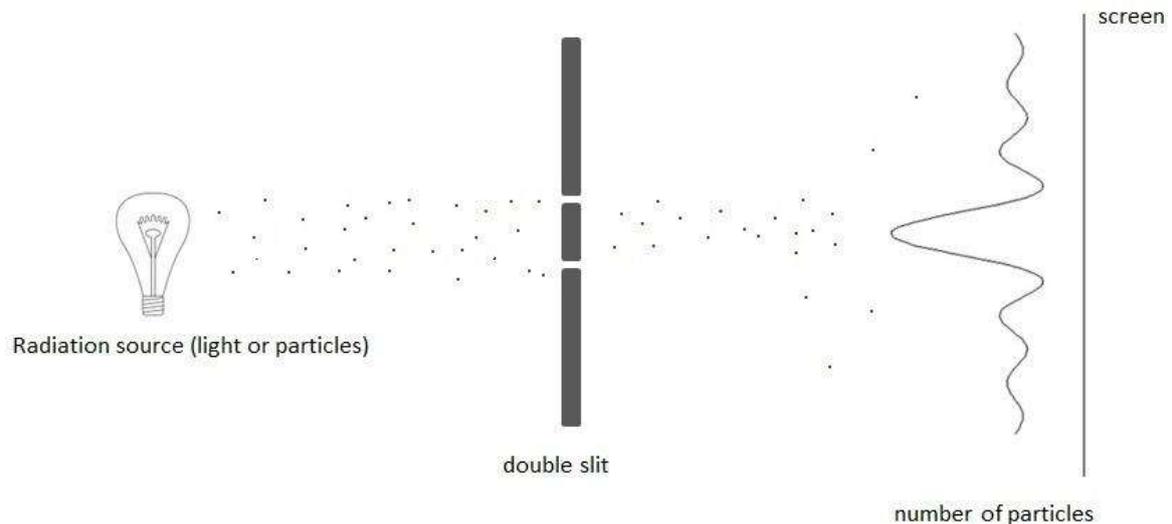
In 1900 Plank understood that you could solve this dilemma, by stating that radiation was not just to do with the field, it also had a component of self-hood, or the internal structure of something existing for itself, something particle-like. Once one assumed with Einstein in 1905 that the radiation could only exist in packets, depending on the frequency, then the predictions exactly matched what was observed. Light had to be both a wave product of the field, and a particle identity of something existing for itself.

*(Despite Einstein intuiting this double nature of wave/ particle for light, it took many years for scientists to accept this, until a decisive experiment by Compton in 1924 actually demonstrated this phenomena. It was odd that Einstein is often portrayed as being resistant to the revolutionary nature of quantum theory, yet it was he who carried the revolutionary idea of the double nature of light, from the start. What he objected to was the interpretation given to quantum theory, which he felt did not fully grasp the essence of the phenomena.)*

Light was both particle identity *and* universal field. Luis de Broglie in 1924 extended this double-nature of identity to elementary particles, as electrons, which in some circumstance, also behaved as wave-oscillations of the background field, just as light.

## The double slit experiment

To test this half particle/ half wave identity, Einstein developed a thought experiment, that was later performed on many occasions. The experiment involved sending one packet of energy, a photon into an apparatus consisting of two slits. The photon having travelled through one slit or the other, then meets a light-sensitive screen, where the incidence is amplified to leave a mark. The double slit experiment it is called.



Number of particles registering at screen appears to show information from both slits in each individual trajectory.

There is one particle in the system. We do the experiment with one photon, and it marks the screen where it hits. We wait a bit, then we do the experiment with the second photon, and it makes a second mark. We wait a bit, then we do the experiment with the third photon, and the particle hits somewhere else. After we have done the experiment hundreds of times spread over time, when we add up all the incidents of where the particle hits the screen, we find an interference pattern. Even though the experiment has worked with single particles, the collective outcome is the order of an interference pattern. The interference pattern would normally be understood as a wave-phenomenon, where the crests and troughs of the passage of the wave through each slit is interfering with each other and so creating dark and light stripes. But here the experiment is working explicitly with particle.

This is a really weird thing. There is an interference pattern, so it is as if the photon is travelling through both slits in order to meet the screen. So we can understand this by saying there is a cloud of becoming which isn't yet fixed, that travels through both slits. For the packet of becoming is about wholeness, holding all its possibilities within it. So it doesn't recognise the separation of the slits. It only becomes something, in the world of separation, when it hits the screen in the world of structure, which causes the cloud to manifest itself, to express itself, to become explicated, in Bohm's language. It becomes explicated with this strange signature of the journey of its origin, which could have gone through both slits, because it was not yet manifest when it was on its journey.

The experiments on the particle world, and the coming into being of the shore of existence gave scientists huge difficulty. They were trying to understand the world through matter, not through wholeness or meaning.

Whether you use light or particle, as an electron, you get the same effect. The particle does not exist until it meets something, until it hits something, meets the world of structure.

### Cloud of unknowing

There exists a cloud of unknowing, within which are the possibilities of becoming something. You have this cloud of unknowing, in which you have wholeness containing all the possibilities. This undecided state of possibility persists until meeting something solid, as an object or somebody looking. Something in the world of structure, at the shore of existence, meets this cloud of unknowing or cloud of becoming. And in this cloud of becoming, where all the possibilities are entrained, when it meets a structure, this cloud comes into existence, and something specific resolves, a particle being measured.

It was presumed that science would get to the shore of existence, come to an abrupt end of these basic particle structures, and reach an understanding at which there would be nothing more to say. Rather, the shore of existence is something a bit fuzzy. It is this possibility of becoming, like the waves breaking on the shore, that when they meet something solid, some structure in the world, then that possibility expresses itself as something –a particle, matter, energy. But before that, it is not anything except this possibility. The finite world is a possibility within wholeness.

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Whether you use light or particle, as an electron, you get the same effect. The particle does not exist until it meets something, until it hits something, meets the world of structure.

As Henri Bortoft said, light is both the setter of the stage of happening, the unseparated background, and the individual separated instances of what actually happens, the foreground reality.

Diana: The observer is the wall?

Philip: Yes good question

If I change the experiment, to put an observer or a detector by the slit to observe if the particle passes through it or not, the outcome pattern changes, as if the particle has either traversed one slit or the other. If I change where the cloud of becoming meets structure, by looking through which slit the particle has traversed, then the cloud of becoming expresses itself differently. The particle now reveals itself at the slits, and so its embodied existence, now passes through one slit or the other. The pattern at the screen changes, from an interference pattern, to showing two peaks of impact directly opposite one slit or the other.

*[By the physicist deciding to insert a measuring device into the experiment by one of the two slits, then the nature of existence modifies itself to the changed observation, by now losing the interference pattern, and aggregating the hits of particles at the screen opposite one slit or the other. There is no longer interference. Trajectories are now direct through one slit or the other. Existence as a response to question, changes.]*

Here is the western scientist in his white coat thinking he is going to get a nice simple answer. And where he looks, changes the outcome of an experiment. He is so involved as participator in the experiment, where he looks changes the outcome.

You can actually decide to erase the information of the recording after the particle has passed through the slit. When you erase the information, you get back to an interference pattern.

Isa: How can you erase the information?

Philip: You can destroy the information by mixing it with another signal. When you erase the information, you get back to the interference pattern.

At the basis of existence, wholeness holds all the possibilities, until it crosses the shore of existence, when it meets structure, it identifies one of these ways of revealing itself. When wholeness reveals itself it does so with a quality. When you meet structure wholeness reveals itself very recognisably and familiarly.

Diana: When they did this experiment they discovered the observer part. The observer needs to be someone?

Philip: The observer can be someone, or some macro structure, or a measuring device, something that grounds the possibility into becoming. Like when you are dreaming and when you wake up, you need something to ground you back in reality. So when you meet the clock saying it is time to get up, the dream world and the matter world meet. The particle is similarly dreaming itself but it only comes into existence when it meets something that allows it to relate this whole cloud of inferred possibility to something real. The cloud disappears. It becomes something specific.

### **Entanglement and non-locality**

Another experiment suggested by Einstein involves two particles that were initially together, and so have associated properties. The particles are split apart and sent away from each other.

*[When one particle is measured, this will involve that one reality will be selected out of all the probabilities foreseen in the physics as to what could happen. But as the two particles are related and must still collectively adhere to the neutrality of the original particle, the choosing of the value of one particle immediately determines the value of the other particle. In other words, how the world responds to the question the physicist asks, traverses the limitation that change is only delivered through the locality.]*

The two particles have complementary properties as they started life together. Because the two particles are related, their neutral totality, implies the value of one particle determines the nature of the other. So the second particle is committed by the measurement on the first to exhibit a property. This is known as entanglement. You do not know what is entangled with what in the universe. So it could be all sorts of things that are miles apart can have this weird connection to each other. And given the Big Bang and that we all started together, we can say this is another quirky thing about this whole cloud of becoming.

Diana: So they relate themselves to have equilibrium to the first state.

The particles starts with zero spin, say. So the particles when you measure them must have together zero spin. The direction of spin discovered in the first particle commits the second particle to hold a complementary property, in harmony to compensate the first. These experiments have all been done.

Brenda: The second particle is compensatory to the first

Isa: They could behave as individual particles, instead they remain linked.

Philip: In measuring one you know something specific about the other.

### Quantum behaviour

Quantum theory works at the fundamental level of packets of energy, asking how did these packets, or quanta, come into the world as something real. It was operating completely differently to the way the world of structure behaved. For immediately you had structure, this cloud of becoming, this pre-shaping of the landscape of reality would identify itself as an actual journey of something realised into the world. At the shore of existence, the cloud of becoming that is only possibility meets structure, and then the landscape reveals from the possibilities an actual journey into something.

Bohr was the first theoretical scientist to investigate the atom. He was seeking to come up with a model of how the atom behaved. Yet the atom seemed to make no sense.

In the atom, there was a positive nucleus with electrons going around it. The electron going around the nucleus should be giving off energy. But in the atom, if it was giving off energy, the electron would be falling into the nucleus. Bohr in 1913 came up with a proposal that the electron does not exist, except when it makes a transition from one state of the atom to another.

Bohr applied the same double nature of wave and particle to the electron limiting its orbits to whole multiples of the wavelength. By calculating the permissible energy states of the electron in the atom Hydrogen, Bohr could show that this also explained the atomic spectrum of colour frequencies characteristic of the element Hydrogen. But this left more questions open than it solved. In 1918 Bohr wrote...

'I know that you understand ... how my life from the scientific point of view passes off in periods of over-happiness and despair, of feeling vigorous and overworked, of starting papers and not getting them published, because all the time I am gradually changing my views about this terrible riddle which the quantum theory is.' (Bohr, 1918)

Karina: As in the film *What the Bleep do we Know?* What you are saying is we have the capacity to materialise things through our thoughts, emotions and imagination.

Philip: Yes at the basic particle level, before nothing becomes something, at the shore of existence the question precedes the manifestation.

Let us come back to the question 'Is this also true on a larger scale'?

Thais: You are saying it is a big assumption to go from particles to wider implications (the movie does that)

Philip: We are going to bring this out into its deeper meaning. Where we are now is just with the science and the enigma of the particle, and then we are going to bring this into the biology.

### All in the mathematics

Bohr was being paid to understand the atom, to come up with a model of how this atom behaved. He was coming up against this perplexing nature of things that seemed to make absolutely no sense. Bohr and Heisenberg were materialists. It was important that they preserved the idea of matter. Even though it seemed like matter was being kicked out of the door. You had to treat wholeness in a serious way.

Bohr and colleagues came up with this very clever solution, known as the Copenhagen interpretation. He enclosed this cloud of unknowing containing the possibilities of becoming as simply existing in the realm of mathematics. He said it had no relation to reality whatsoever. This is just a mathematical terrain. Only the mathematics is able to understand this reality. No other way exists to understand this.

Bohr and his Copenhagen colleagues, including Heisenberg and Pauli, came up with the Copenhagen interpretation. This pre-reality to the shore of existence was not about wholeness, it was simply a mathematical oddity so that the only way you could understand the particle realm was through mathematics. Your senses, your intellect, your being human could not get to this reality, unless you were a mathematician.

He also subtly changed the terminology of how the world of structure brought these possibilities into being, by focussing on the philosophical idea of measurement. It was only at measurement, that this world of mathematics turned into something concrete. So that again it was only the scientist committing the experiment to measurement, who was capable of turning the mathematical realm of possibility into something real.

## Concealment

The Copenhagen Interpretation weaves a huge web of concealment around the subject of the atom. The way this was argued by Bohr was often incredibly difficult to understand. You could never get to the meaning. Bohr convinced the physics community, by a mixture of bullying and bluffing. The particle world had nothing to do with reality, it was just this mathematical reality, that at measurement turned into something real. And hey presto, all the problems had gone. A conjuring act that made people feel they had solved the whole problem of existence.

Karina: In *Taking Appearance Seriously*, Bortoft says “The founders of modern science were educated in the mathematical approach to nature. What were called the primary qualities were simply those aspects of nature that appeared in the light of mathematics. Although it is nature that shows up in this light, this is by no means the only way that nature can appear.”

Before quantum theory the qualities of existence were in nature. Science was about observing. Now there is a complete turnaround as to what are the qualities of existence. Bohr is claiming that is only through physics that we can get to the basis quality of existence. It is only through the mathematics, we really understand what is going on. It has nothing to do with the chestnut tree any more, or compassion or love. There is this basic mathematical foundation which measurement materialises. It is us who are bringing the world into existence, who are giving the world structure. There are no longer qualities out there that we are trying to meet. Einstein and others completely rejected this, saying it was a complete deception, which he called the Heisenberg – Bohr tranquilising philosophy or religion, as gentle pillow for the true believer.

Once you have made this deception, once you have convinced everybody that it is the mathematics and the measurement and man that is giving the structure, you are stuck in that way of thinking, because all of reality is now artificial, man made.

Karina: It is a need of control, fear of the unknown

Philip: This is a story I have told many times that illustrates this. When I was a child I had a desk with one key. And I thought the key does not really secure the desk because if I lose the key somebody else can get in the desk. So I had the idea of taking the key and putting it through the slit into the drawer that was locked. And this was brilliant for now it was a real key. Because now nobody, not even me could get in. This was like the theory that rationality had come up with, something that was totally fool proof. Rationality had come up with something that claimed dominion over the world, not in some vague way like Newton, but by saying any other approach to reality, apart from the mathematics, and measurement, will not meet reality.

## Back door of meaning

Let us dwell a minute on the amazing thing of what happened then. Science was sure it had captured for reason the flag of existence as if meaning was totally out of the window. It was only man's concepts that gave the world reality.

In 1938 they discovered a consequence to the fact that the nucleus of the atom could be split apart. If you fired a neutron at the nucleus, not only did the nucleus split, but it gave off two more neutrons, and those two neutrons could split two more atoms and so on down the line. The atom could split into elements which had a smaller total mass than the original element and the difference in matter was given off as energy. This reaction had the possibility of giving out huge amounts of energy.

In 1941, Bohr was Jewish living in German occupied Denmark, Heisenberg was German. Heisenberg went to see Bohr in occupied Denmark. Neither of them knew if the other side was developing the atom bomb. And these two people had developed quantum theory as a theory of matter. Now they were enemies approaching each other as representatives of these two sides. And the whole destruction of the planet was between them. But because they had used such cryptic language, they could not communicate or be honest. They distrusted each other.

‘Bohr was shocked by my reply, obviously assuming that I had intended to convey to him that Germany had made great progress in the direction of manufacturing atomic weapons. Although I tried subsequently to correct this false impression I probably did not succeed in winning Bohr's complete trust.’ (*Heisenberg, 1956*)

‘I listened to this without speaking since a great matter for mankind was at issue in which, despite our personal friendship, we had to be regarded as representatives of two sides engaged in mortal combat. That my silence and gravity, as you write in the letter, could be taken as an expression of shock at your reports that it was possible to make an atomic bomb is a quite peculiar misunderstanding, which must be due to the great tension in your own mind.’ (*Bohr, 1956*)

When you have got rid of meaning, in this subterfuge way, what remains is a complete lack of trust, a lack of the ability to communicate. The final subterfuge of matter to get rid of meaning played itself out in this most meaningful way. These two people engaged in combat, in which there was no bridge of humanity, no bridge of a value to be shared.

Heisenberg some people say deliberately stayed in charge of the German program in order not to make the bomb. But the Americans did make the bomb. And this was the final journey to destruction. When there is no meaning in the world, all you end up with is this destructive power.

We have to relinquish the idea of reality existing in the expectation of the mathematics and measurement.

The only thing that exists is measurement. We are only who we are when we live up to the expectation of how we are seen. That is how we live. We live as if science is the only thing that is important and at the same time, all that is real is how we look to others, how we are measured.

So we have to go another way than this.

Let us go to another figure. You can see a nice picture of the three of them here.



Bohr, Heisenberg and Pauli at the Niels Bohr Institute lunchroom, Copenhagen Conference. June 1936 (Credit: Niels Bohr Archive Copenhagen)

The third person is Pauli.

### **The world clock of harmony**

Wolfgang Pauli was also involved in the construction of quantum theory. Pauli had a completely different story. In 1928 Pauli had a nervous breakdown, after an emotional trauma, and sought help from Jung. Both were living in Zurich. Pauli, as by-product of his analysis, started having these dreams, the first one being of a world clock. There were these monks around a golden disk and this beautiful clock of world harmony was moving around. There were these basic proportions of 3 and 4.

Pauli then dreamed of Einstein, as follow:

‘Among others, I had the following dream at the time, and it preoccupied me for years. “A man resembling Einstein is drawing a figure on a board. This was apparently connected with the controversy described [on the foundation of physics] and seemed to contain a sort of response to it from the unconscious. It showed me quantum mechanics and so-called official physics in general as a one-dimensional section of a two-dimensional, more meaningful world, the second dimension of which could be only the unconscious and the archetypes.”’  
(Meier, p .121, 122)

Pauli comes right into the relation of matter and meaning. There were these two dimensions. Physics was stuck in the dimension of matter. Physics was ignoring the meaning. He went on having these dreams in terms of physics. They insisted on meaning.

‘What I understand by “background physics” is the appearance of quantitative terms and concepts from physics in spontaneous fantasies in a qualitative and figurative – i.e. symbolic - sense. I have been familiar with the existence of this phenomenon for about 12 to 13 years from my own personal dreams, which are totally uninfluenced by other people. As examples of the physical terms that can appear as symbols, I should like to list the following without any claim to completeness: wave, electric dipole, thermoelectricity, magnetism, atom, electron shells, atomic nucleus, radioactivity.’ (Pauli 1948, p.179)

He comes right into our court that is about matter and meaning. Physics was ignoring the meaning. He went on having these dreams in terms of physics about meaning. He developed synchronicity.

Pauli changed direction in realising that what quantum theory was trying to express was of great importance in the life of meaning in the world, telling a journey that in the end led back to the wholeness of the world, the harmony of the world, the whole sense of meaning of the world.

He realised that this understanding of the shore of existence, where something of the whole cloud of becoming came into being, it wasn't just describing this shore of existence of matter, it was also describing the far shore of existence of meaning. It was describing how we know about the wholeness of existence. He would dream the particles, the radioactivity and matter in the unifying of all opposites, the male and the female, with these strange symbols. He would dream about his own psyche. He realised actually this whole subterfuge of physics, on measurement and mathematics that led to the destruction of the world, also held within it the seeds of creation.

Schrodinger: life is in a certain sense the whole that cannot be surveyed in one single glance.

To draw back to yesterday, lets put all this together. We start at the shore of existence, where the particle comes into being. Yet that particle cannot be itself until it meets some structure, for that is the nature of the shore of existence.

Life is never fixing anything. It is always allowing everything to be free. So the whole cloud of becoming, is something we are born into, and as we do not fix ourselves as structure, the whole cloud of becoming can exist in a state of non being. What can solidify this cloud of becoming, in seeing physics and biology together, which causes the cloud of becoming to be realised, is when individual possibility is able to find coherence with others. The aim of life is to find coherence, in which the whole cloud of becoming is able to reveal the essence of existence. Our very nature is to seek coherence. That is why it such an innate drive in us, to take this journey from the shore of matter to the shore of meaning. What Pauli recognised in his dreams was that humanity itself, along with the atom and the cell, was a seeking for coherence. This is the most real journey, the primary journey.

Pauli changed direction in realising that what quantum theory was trying to express was of great importance in the life of meaning of the world. It was telling a journey that in the end led back to the wholeness of the world, the harmony of the world, the whole sense of meaning of the world.

He realised that this understanding of the shore of existence, where something of the whole cloud of becoming came into being, it wasn't just describing this shore of existence of matter, it was also describing the far shore of existence of meaning. It was describing how do we know about the wholeness of existence.

He would dream of the same terms of physics, but in the unifying of all opposites, the dark female figure and their attempt to unify. It wouldn't be about mathematics, he would dream about his own deepest challenge of his psyche and its whole expression. He realised this whole subterfuge we placed on physics, about mathematics and measurement, which led to the destruction of the world, also held within it the seeds of creation.

We could really meet again the unity of the world by understanding how wholeness revealed itself in the shore of existence, and not just in the shore of existence of matter, but the shore of existence of meaning. It was not an intellectual thing he was experiencing. It was an active participation in the world that reveals how meaning comes into being. Pauli said the primal realm of the shore of existence of matter was reflected in the shore of existence of meaning, where the universe was weighed in its ultimate value.

Pauli was convinced that what quantum theory was about was this station on the journey of the soul to find itself anew. The understanding of physics had this totally different aspect of unity and meaning and coming to the self, in which all these aspects of tension, male-female, harmony-disorder, found a way of presenting themselves.

This dream imagery draws him upon an underground way. Nothing is stated specifically. There is instead a feeling that there is something afoot in the world, something wants to be born in the world, an ancient story that wants to be told about meaning. Like this cloud of becoming, we do not see this story, we get glimpses of it, but when we try to hold it, it is not really there. It is not like this, this and this happens and the story is finished. There are signs and clues that we are living in this special age that arrives at this shore of existence where meaning is finally tested. And the atom bomb is symbolic, as the test of the point of destruction. But in Pauli's dreams we also meet this encounter with the testing point of creation. And it is totally underground. There is no religion saying this. You meet people on the way, who are open to that test, to the invisible story.

It is about our journey as human beings.

Mike: Schrödinger:

“Inconceivable as it seems to ordinary reason, you and all other conscious beings as such, are all in all. Hence this life of yours that you are living is not merely a piece of the entire

existence, but is in a certain sense the whole. Only this whole is not constituted so that it can be surveyed in one single glance.” [reference]

The profound realisation of Pauli was that quantum theory is not about something we imperfectly understand, but it is about something we imperfectly are able to live. As he said in his criticism of Einstein’s stance.

“The physical theory did have a subjective aspect as well, inasmuch as it is no longer possible to define a state of microphysical objects that is dependent on how (with which setup) these objects are measured. I remarked to Bohr at the time that Einstein was regarding as an imperfection of wave mechanics within physics what in fact was an imperfection of physics within life. Nevertheless, I had to admit there was an imperfection or incompleteness somewhere [as claimed by Einstein] even if it was outside the realm of physics.

Today (1953) I know that this is the pair of opposites completeness versus objectivity and that despite Einstein’s claims it is not possible to have both at the same time. Here once again is the situation of “*sacrifice and choice*”, as in the uncertainty relation of quantum physics itself. I could not deny *that what is a statistical way of describing nature also requires a complementary understanding of the individual case*: but at the same time I saw that the *laws of probability* of the new theory were the most that could be hoped for within an objective (ie non-psychological here) framework of the laws of nature.” (Pauli in Meier, p.121)

*[Philip At the shore of becoming of meaning, the story and the question that are in existence, similarly precede the events that play out in response. Sometime we respond to existence, not out of psychology, or utilitarianism, but out of a basic response to the world as we are called into being by it. It is this story that is more appropriate, when trying to make sense of quantum effects in biology.*

*The story of Genesis is in this way not about the world, as a literal counterpart to Darwin, but is a response of early Jewish culture to the question of existence, as it showed itself in events. The world responds to know itself as world. The world exists for the seeing. Existence goes as far as fulfilling the demands of observation that are addressed to it.*

*Myth is a response to know the world as something more fundamentally seen in its living.]*

## Chapter 8

### Quantum Biology with Soul.

Silence for nearly 2 minutes

#### Into the Cloud of Unknowing

Mike: So that will have hopefully brought us into a nice 'cloud of unknowing'.....we hope! I know I've done a few readings today already, but this one is really suited to what we've been talking about. This one isn't about monkeys! It's by a late 14th century English monk....

*"You will ask me, 'How am I to think of God himself, and what is he?' and I cannot answer you except to say 'I do not know!' for with this question you have brought me into the same darkness, the same cloud of unknowing where I want you to be! For though we through the grace of God can know fully about all other matters, and think about them - yes, even the very works of God himself - yet of God himself can no one think. Therefore I will leave on one side everything I can think, and choose for my love that thing which I cannot think! Why? Because he may well be loved, but not thought. By love he can be caught and held, but by thinking never."<sup>12</sup>*

So, Philip has set things up very nicely, as always. What I want to do is to explore some of the implications of quantum physics for biology and for us as organisms. There is a very new evolving field in biology called quantum biology; it is at very early days. There is always a kind of criticism of new age descriptions of quantum physics. But, the 14th century mystic that I just quoted had an innate understanding of this cloud of unknowing, this potential for possibilities which exists. So, it's all very well for the mainstream to say "Ah it's 'woo woo', it's quantum mysticism!", but if the mystics through the years have been able to tap into the cloud of unknowing and be open to possibilities through their hearts normally, not just their heads, or maybe a combination of both, then there is something deep about reality, which the analytical reductionist mode cannot see. However, I'm not criticising that, because a true holistic science has all of those things together.

#### The Adaptive Mutation Mystery<sup>13</sup>

I'm going to start off with a little story, a puzzle, which some scientists in the 1980s had to deal with, which had to do with itsy teeny tiny winy bacteria called *Escherichia coli*. They live in the gut and they're good for us. So, if we eat our yoghurt in the morning, live bugs can contribute to our general health! There was a big puzzle [called adaptive mutation], which completely went against the story of evolution as a random process; a random process, in terms of random mutations in DNA, which lead to evolution by natural selection and the survival of the fittest.

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<sup>12</sup> <http://www.goodnews.ie/wisdomlinejunenew.shtml>

<sup>13</sup> The paper being discussed is: McFadden, J. & Al-Khalili, J. (1999) A quantum mechanical model of adaptive mutation. *BioSystems* 50 (1999) 203–211.

Although there is still a lot that is not clear about that process, this experiment was thoroughly confusing; nobody believed it. The experiments involved the scientists using a strain of bacteria, which had a mutation, meaning that it couldn't metabolise the sugar lactose in a fermentation process. The mutation [was] in the gene for lactase, which is normally required to break down the lactose.

They put the bugs into a vessel and they added chemicals to feed them, but they also limited the oxygen supply, so the bugs couldn't divide properly. And then they added the lactose, the sugar. Now, remember that these bugs did not initially have the gene for lactase. But when [the scientists] took the bacteria out and grew them on culture plates in the lab, there was now a high proportion of bacteria, which had suddenly gained the ability to metabolise lactose - out of nowhere!

And they did the control experiments - they could be sure that whatever mutations were occurring in the DNA, to bring about the expression of the lactase gene and therefore the lactase enzyme, [were] occurring much more rapidly than [they] possibly could by random mutations. In other words, it went against the whole Neo-Darwinist view of random mutations leading to evolution. The experiment complicated things considerably. Subsequently, there were other experiments that were done - variations on this theme, other bacteria of other strains. This phenomenon, of bacteria being able to evolve enzymes [spontaneously was shown to be quite common].

Thais: Did they manage to pinpoint where this occurred? Was it in the mother cell and then it appeared in the two daughter cells?

Mike: Well, what would normally happen for this to occur by random mutation would be that the mutations would occur during cell division, but what was happening here was [that] because of the limiting oxygen in the culture, the cells simply couldn't divide. So, you had a suspension of bacteria in a liquid medium that contained lactose, the sugar, but these bacteria did not [start out with] the enzyme to actually break down the sugar. But, when you took a sample of them and you put them on plates containing lactose, the cultures would grow, because individual cells had miraculously (we'll say) gained the ability to metabolise lactose to provide energy for cell division. Does that make sense? [quiet murmurings of understanding]. Well, it didn't make sense to the scientists, so you're doing better than they [were]!

So, a big mystery! What's going on? So, interestingly, the guys who wrote the book that Philip threw across the room the other day weren't all bad! Johnjoe McFadden and Jim Al Khalili were having meetings in coffee bars in Surrey University for years, where they both worked, just getting together and having a brainstorm about quantum biology and why does this happen? No one has an explanation for this.

So, McFadden is the biochemist and Al Khalili is the physicist. They began to think about some of the implications of the [quantum] physics that Philip has been describing this morning. The general

consensus amongst physicists and certainly amongst biologists, who quite frankly generally don't have a clue about quantum physics - biology is still generally very much stuck in its Newtonian world of cause and effect....

So, Al Khalili and McFadden were getting together over coffee. All Al Khalili's friends and colleagues were saying "Don't even bother with this quantum biology stuff - it's wacky - you're going to ruin your career if you get involved in this"! But, they persevered and McFadden had this idea, a sudden insight, where he thought maybe there's something related to quantum physics here. Maybe, there is some sort of choosing of a possibility within the DNA that [enables] this enzyme to appear. So, he's already thinking about the cloud of unknowing.

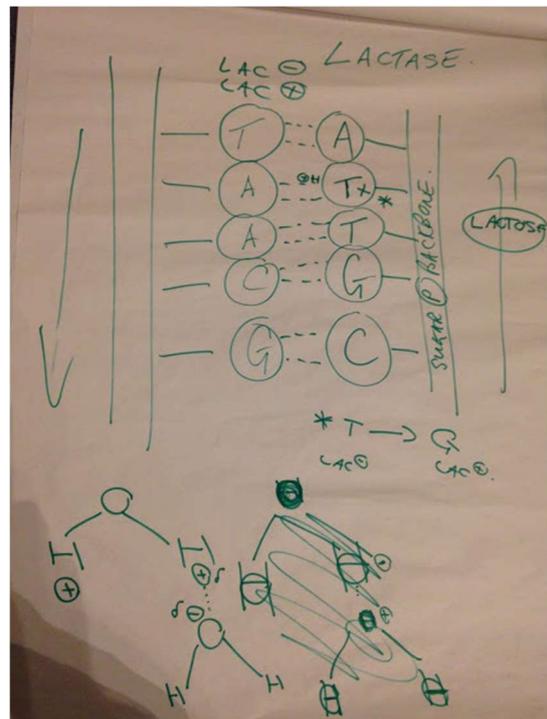
Also, Philip mentioned this concept of a superposition of states. So, you might have heard of Schrödinger's cat - the idea that the cat can be [both] dead or alive. So, what McFadden was thinking about was that in the bacteria, the [mutated] DNA that could [evolve] to produce the lactase enzyme could exist in a superposition of states. In other words, the bacteria had a mutation [in] the gene for lactase. But within the cloud of unknowing (not that McFadden called it that! But, we are!), there was always the possibility that the bacteria were going to be able to produce the enzyme.

So, I have to take you on a little 'reminder journey' about DNA again. [Draws on flip chart]. The superposition of states is if you think of the cloud of unknowing as being all the possibilities for all the nucleotide sequences for the lactase enzyme [gene]. They all exist within that cloud of possibilities. It's just that nature has chosen one particular sequence, which is able to produce a protein, which metabolises lactose, this sugar. But the bugs did not physically have the material gene for lactase.

Alex: In other words, it was impossible!

Mike: It was impossible according to a materialistic, non-quantum paradigm.

Thais: Because we always learn that DNA is so specific and so structured. Only random, very rare mutations can alter it. But here we are seeing exactly the opposite, like Lego pieces that come together through its relation to the environment.



Mike: Right! I'll leave and you can take the rest of the class! That's perfect! [laughter]. That is the crucial thing - this interaction with the environment. If you look at this Copenhagen view of quantum physics, this diagram that Philip has put up. This was Bohr and Heisenberg's pet theory, which became known as the Copenhagen interpretation. The big problem, as we discussed - well, there are potentially many problems with it! But the biggest problem is, if it requires measurement, if there is a requirement for measurement, at what point does the measurement occur?

Mainstream quantum physics is still mostly saying that these effects only occur in the microscopic world. But, if you bring in a measuring device of some sort, that's part of the macroscopic world and then there is this idea that all the possibilities collapse into one actuality and this creates the material reality. But there's no concept [of] at what point this cloud of unknowing actualises itself. In other words, the superposition of states collapses into one actuality. So, there is a question about the point at which the measurement is allowed to occur....I've lost my train of thought....it's catching!..... ah...that's it! [laughter] - thank you! So, We talked about coherence, so the interaction with the environment brings about something called decoherence and the decoherence is the act of collapse. Is that correct?

Philip: Mmmm *[agrees!]*

### **The Cloud Actualises**

So, the question becomes how long does this cloud of becoming or unknowing or knowing stick around for? Does it stay around long enough for something useful [such as an enzyme] to collapse into actuality. Usually, in order to demonstrate this quantum [effect] physicists and biologists would freeze the system down to almost absolute zero, because, the argument goes that the warmth of the every day world, the chaos in the every day world, this interaction between the cloud of unknowing and the environment, is causing this decoherence, which collapses something into actuality pretty much immediately in the real world! [So, maintaining the system at near absolute zero maintains the cloud of unknowing]. So, that is partly the explanation as to why we have 'real' [material] things in the world - is that because of this macro chaos, this interaction between the macro world and the cloud of unknowing, that things collapse very quickly. They won't collapse if you freeze them right down to zero Kelvin to do these experiments.

Brenda: So, what do you mean when you say collapse?

Mike: I'm talking about a superposition of states, so all these little dots are in the cloud of unknowing. Imagine this whole cloud as water vapour coalescing and condensing into a single water droplet. So, it's like the whole cloud collapses and a raindrop falls out of it.

Philip: Collapse is not a good word, because it's something that expresses itself, it actualises.

Mike: You're right, it's not, but 'collapse' is the word that is used in mainstream physics.

Philip: Yes

Mike: But again, we run into names and ways of thinking. So, what's actually happening, as Philip quite rightly says, is that you have a potential for a raindrop within this cloud. The water vapour yearns to express itself as a raindrop.

Thais: It's 'collapse' in the sense of coming together. Not collapse in the sense of breaking apart.

Mike: Yes

Philip: And it's 'collapse' in the sense that all the possibilities for what gets expressed are no longer there.

Isa: And also because it's like a cloud coming into a more dense state.

Philip: A particular state. One of the possibilities gets expressed and the others [don't].

Ole: Otherwise, we would have the idea, there are all these particles creating the drop, but actually they are not particles in the cloud.

Mike: Yes, exactly.

Alex: And that language is there in the science too isn't it - the collapse of the wave function.

Mike: But, this is instantaneous. So, this is the big question about quantum biology. There are a lot of physicists who don't even think that quantum biology is possible because of the fact that we are fuzzy warm creatures (some of us more fuzzy than others) [looking at Alex who is unshaven; laughter]. So, those are the arguments against quantum events having a role in the macro world, particularly the macro world of biological systems.

### **Quantum Molecular Dyslexia**

So, back to our little bacteria story with the lactose. We talked the other day about DNA strands [continues writing on the flip chart]. Pretend that this sequence represents our lactase enzyme. These [nucleotides] pair up with the strand running in the opposite direction. The nucleotides are also linked to this sugar phosphate backbone, and the same thing on this side. So, one strand running this way and one strand running that way. So, what holds these together is hydrogen bonds. The H bonds are very weak forces between these molecules that hold water together. So, you have H<sub>2</sub>O, so there's the 'H' and there's the two 'O's...but what actually happens then is that the water molecules stick together.....

?: No! two H's and one O!

Mike: Aaaagh It's my dyslexia coming back again! [laughter]. I've got molecular dyslexia. I knew that was wrong the minute I did it. Now I've thoroughly confused the issue. It's been a while since I've done this! The point is that this hydrogen has a slightly negative charge and these oxygens have a slightly positive charge.<sup>14</sup>

?: No, the other way around!

Mike: I wasn't expecting to have to explain H bonding! Let's start again! Does someone else want to do this? [more laughter] So, the H is a little bit positive (delta plus) and the O is relatively minus (delta minus). What happens is that you get hydrogen bonds, which are an electrostatic attraction between the water molecules. And that's why water is not a gas. [Based on its molecular weight alone] water should be a gas. And then what happens when water freezes is that it becomes more ordered, which is why water expands when it freezes! Sorry for the mess!

So, [looking at] this sequence of our gene for lactase, if we think about the mutant - the bad copy of the lactase gene, we will say that this T is the weak link in the chain - that is the mutation. And what has to happen for this lac negative bacteria to become a lac positive bacteria, so that it can produce the lactase gene, [is that] the T needs to go to a G. But, actually, all that [really] needs to happen is a change in a proton - an H - to get a lac positive bacteria, through a change in the hydrogen bonding, to make a new nucleotide, which is changing the gene sequence.

### DNA Clouds and Meaning

What is actually happening with regard to this relationship of matter and meaning is that the simple presence of the lactose in the medium is causing the lac positive bacteria to appear. The presence of the lactose in the environment is acting like a measuring device, [presumably] through the quantum effects we've been discussing, like entanglement and non-locality. We have the possibility within the cloud of unknowing of the DNA [of the lac positive form of the gene], even though this DNA is mutated [and is lac negative].

So, [we have to] stop thinking about the DNA as something that is already fixed. What's happening here is that the T and the G, both exist as possibilities within the cloud of unknowing, the cloud of DNA, if you want to think of it that way. But, [according to mainstream physics], this can't happen because this is a biological system at room temperature or body temperature. So, somehow, the [presence of the] lactose is bringing about a meaningful change in the sequence of the DNA. So, in other words, the DNA is existing in a superposition of states until the lactose appears in the medium.

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<sup>14</sup> In reading this back and transcribing, I realize that I was also inhabiting the cloud today! Not so much in the analytical 'left brain' mode of thinking, but in a different mode - perhaps more suited to understanding or intuiting the mysteries of the quantum!

The Copenhagen interpretation would say that the lactose in the medium is the measuring device. As soon as the lactose is there, it causes the expression of the lactase gene, because it's like the raindrop that is [coalescing] out of the water vapour. In other words, the [appearance of the G is like the appearance of] the raindrop.

Fabio: Mike how complex are the nucleotides?

Mike: So this is the point - it's possible, through a slight change in a proton, to get a shift from one nucleotide to another.

*[Philip: Life steps forward in evolution by the innate coupling of whole identity and the various potentials of how for instance bacteria glean energy from the environment. Such What we are saying is that there exists a phenomenon, the reversing of the lactose processing capability which cannot be explained except by the addition of a theory which in some sense foresees the consequence within a larger collective outcome of other related predictions. What makes the bacteria is this foresight to know itself in relation to this or any other specialist environment. (Also other documented cases of genetic changes of bacteria in relation to the environment (for instance Ben Jacob) [references]. The law of bacterial mutability is then that bacterial identity leaves open this question that is foreseen with many different alternatives of relation to the environment that is crucial for the existence of the bacteria. To be a bacteria means that this superposition of states in its own range of possibilities is shaped by the environment. This capability of bacteria to be multiply adaptive to their environment is the openness of possibility that weave together the whole identity typical of this existence.*

*The question that is asked of existence is the survival of the bacteria that is foreseen in the responses of the organism to process energy in varied ways.]*

Sindhu: Can you please say about the raindrop again?

Mike: So, the cloud of unknowing is like the water vapour. So, you know how raindrops form, because small particles appear in the atmosphere. So, the lactose is almost acting like a particle, which is communicating with this cloud, which is causing the G to appear from it to make the right sequence to make the enzyme lactase appear out of nowhere effectively, because it wasn't there before. But the possibility for it to be there always existed.

Ole: I have one question [about] the experiment. So, the scientists first looked at the DNA and the possibility [for lactase expression] is not there and so it is actualised that it is not there. And then it was out of view and into the lactose, which would mean that I have actualised it, but ,by taking it out of view, the cloud appears again. It's a question now.....So, if I'm looking at the door, and then I look away, the door could be not there. Once fixed, is it fixed forever?

Mike: So, this is the famous Bishop Berkeley thing about whether "*If a tree falls in a forest and no one is around to hear it, does it make a sound*"?

Ole: For me the question is, did they first check the DNA sequence?

Mike; So, they would have sequenced the DNA first of all to see [that] there is a mutation and then they would have sequenced the DNA after the experiment to see if it was now so-called wild type – [if] it was [now] able to metabolise the lactose. But the mystery is [that] there was no explanation as to where this [wild type gene sequence] came from.

Now this is just a theory, but it's becoming much more respected [because] there are a whole bunch of other experiments now that have been done in other areas of quantum biology, which clearly show that biological systems are capable of maintaining molecules in a quantum state of superposition. In other words, they aren't yet actualised.

And the implications of that are utterly mind blowing because it means that these weird spooky effects that Einstein didn't like, that for years people have known to occur in the micro world, like non-locality, entanglement, superposition for example [might apply to the macro world too]!

If you go back to mysticism, there are reports of saints being in two places at the same time - so how do you explain that [if it's true]? We should be careful about not drifting off into quantum mysticism, but there is now a legitimate case for having a good philosophical discussion about the implications about all of this, because, generally, what's happened with quantum physics is that - again, going back to Heidegger - he said "*Science doesn't think*". Quantum physicists have been brilliant at [laying the foundations] for designing high whizz technology, but they haven't always thought about the philosophical implications of [quantum physics].

If you've got a situation where within DNA there is a superposition of states [and the expression of one state] is activated by something in the environment, [then] there is some sort of coalescing or arising of matter through meaning, because the lactose provides a different context in the environment when it [is present]. I don't know if you can comment on this in this context Philip, but my feeling is that the lactose is providing a different meaning to express itself from this cloud.

There is a creative act here - something is appearing in the world that wasn't there before through some sort of interaction. Now what that interaction is another issue and we can maybe discuss whether it is meaning or not.

Brenda: Mike, so how would this be different to all the examples we have seen of mutation. I'm struggling a little bit - because normally with mutation, this is how it happens. So, how does this superposition of states differ from the other mutations we have seen?

Mike: Because in Neo-Darwinism, which is this molecular genetic interpretation, mutations simply happen randomly - by chance - and it's usually the case that the mutations occur [during cell division]. Then, those mutations are passed on to the next generation and then there is a selection of the fittest, survival of the fittest - red in tooth and claw etc. But, here you have a situation where the organism is an active creative agent in its response to the environment [at the genetic level]. There is an external chemical – lactose - in the medium, which is able to actualise the [nucleotide change], which results in the possibility of the [lactase] enzyme [being expressed] or appearing. The bugs will just stay in this state of stasis. They don't have any nutrition if they can't metabolise the lactose, so they're driven to express themselves by producing the lactase enzyme, which will metabolise the lactose.

### Life, Expression in Context

Fabio: So, Mike, does this happen if you just throw a piece of DNA in the medium?

Mike: Well, that's a good question. I don't honestly know the answer to that. It brings up more questions about context and what life is! So, we talk about genes being expressed during development, for example. Actually, the way the genes are read is very much dependent on the type of cell [that] they're expressed in. My feeling is that there is something about being inside the cell, which is important here for the creative expression. There is a new meaning, which suddenly emerges in this quantum leap, this sudden moment of insight where the bug goes *"Eureka, I've got it! I can produce G instead of T and I can metabolise lactose!"*

Fabio: Where we draw the line on life is also relative. Because proteins can manifest themselves in water and create the kinds of things we were talking about yesterday. So, what we see as life in a bacterium can just be a complex community of DNA and other things coming together.

Evelyn: This is the place where the conversation about the cell membrane comes in, but I can't really continue the conversation! [laughter] But I feel that maybe that's where it comes in.

Mike: Yes, well it's about the cell membrane being the boundary, the liminal space that separates the internal environment from the external environment and there's a different context within the cell membrane than there is outside the cell membrane.

Thais: I have a feeling that this is more connected to Lamarckism than it is to Darwinism.

Mike: Yes, exactly. So Lamarck was a [forerunner] of Darwin and his argument was that [acquired] genetic change from the environment can be passed on through generations. And that is also now known to be true through something called epigenetics. The implications are actually quite astounding. For example, in the way that the media represents genes - that we are victims of our genes for example. [But perhaps] we can be active agents [in the modulation of our DNA]. There is certainly evidence for changes in our DNA through epigenetics, but that is a whole other lecture.

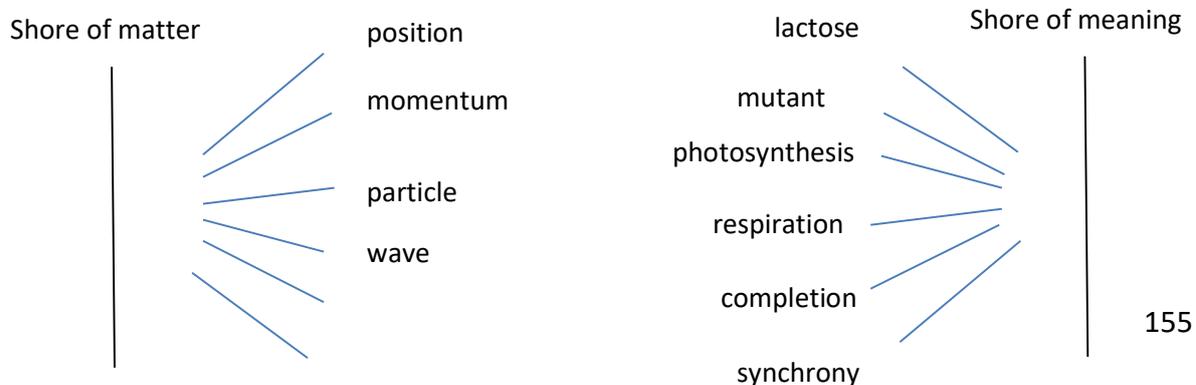
Thais: There are moral and ethical implications - they try to find a gene for sociopaths. How are we going to treat these people? Can we find those genes [involved]? This has huge implications for that.

### Applied Quantum Biology

Mike: This [the quantum biology explanation for the lactose experiments] is to some extent theoretical, but there are other examples, which I'll just outline, where experiments have been done that [show that] these quantum type effects are actually occurring in biological systems. The best, most well worked out one is in photosynthesis. In photosynthesis there is a chlorophyll molecule and this has a kind of antenna on it, which catches photons. The big mystery has been why is photosynthesis so efficient? The photon has to be captured by the antenna of the chlorophyll and then what has to happen is that the energy created along this chain of events has to result in the combining of CO<sub>2</sub> with water to make glucose C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>, which is a carbon 'building block' for life. No one could explain why it is so efficient, but believe it or not, what experimenters have done - physicists and biologists - is they have shown that when the photon comes in, it brings about a situation in a reaction complex where electrons are released like little dogs that run off. But there was a big mystery about which path these electrons follow. So, why do they go in particular directions and not other directions?

It turns out that it's like the double slit experiment again. The electrons actually go out as a cloud. They're not existing as electrons, matter as such, like little water droplets that have coalesced. They exist as the cloud. So, they go out [in the cloud] and explore all possibilities and they meet the next link in the [electron transport] chain and then there is something called backward causation, where the cloud coalesces to put the electron right where it needs to be. It's incredible. And people think also that that's how our respiratory chains [in mitochondria] work as well. So, photosynthesis is not dis-similar to respiration; it's kind of the opposite. In plants, chloroplasts that contain chlorophyll bring about this production of energy [as do] mitochondria, so it's a loop. Photosynthesis is taking in CO<sub>2</sub> and producing oxygen, we're taking in O<sub>2</sub> and producing CO<sub>2</sub>.

*[Philip: Photosynthesis vouchsafes the existence of the plant or the bacteria conditional on other related equally improbable attainments that add up to a unity of mutually supporting activity.]*



time

energy

The material is posited in the questions of existence that cross the bridge of emptiness. The miraculous is vouchsafed in the cycle of attainments that together fulfil wholeness.]

These quantum effects are really at the heart of it. What is so astounding about it is that there is something about the environment within the cell, within the chloroplast, which is able to maintain these electrons as a wave of possibilities just as these [lactase] DNA sequences are existing as waves of possibilities. There are other examples as well.

Fabio: When you drew the zygote and it creates an axis even with one cell and you have a concentration of one protein, do you see the proteins or do they manifest?

Mike: I don't know! Brilliant question. I don't think anyone's even asked that question before. So, do they only appear when the scientist looks at them? There are interesting philosophical questions about us and how we relate to the world. Are we fixed in place or do we exist as a sea of possibilities?

Jörn: One about the enzymes and the relation to food intolerance, because I'm very affected by that. And I had an 'Aha' Moment, where I [realised] I'm not the victim of that, although it is mainly associated with the enzyme [that is] missing. But, in the end, it's about if I feel that I'm the victim of it or not. And this might trigger quantum effects that can heal that.

[lunchtime gong sounds loudly]

Mike: Well, that's this whole bigger issue of this in all sorts of arenas of life, including healing and medicine.

Ole: In Sufism there is this very old already practice of explaining it this way.

Mike: Some of you might have heard of the Bach flower remedies.....

[the gong gets louder]

Mike: She's getting a bit carried away [laughter]....

Isa: It's the same person! It's her day!

Mike: The flower remedies have to do with vibrations and the energies of flowers. Some people will say it's all "woo, woo!", but we know it works. I have a friend who is a practitioner. He treats all sorts of people using this method. Another, big mystery has been how we smell. How are we capable of identifying so many different smells? So, the traditional view is the lock and key idea. There is a chemical that binds to a receptor and that sets off a whole chain of mechanical events that results in us sensing a smell. The quantum biology suggestion is that what is happening is that the receptors are resonating with the chemicals that we're smelling. So, there's a particular vibrational frequency that is associated with particular molecules. So, one mystery has been why [do] two chemicals, which basically have similar structure, smell differently? But, when the experiments have been done, it's been shown that they vibrate in different ways [references required]. So, there is the possibility..... [the gong returns]....

Thais: We should invite her to gong meditation!

Mike: I realise it's nearly time for lunch...

Evelyn: I just wanted to cross-reference the flower remedies with plants to your paper [Philip] "Characterising Plants in the Field" and that the cloud of possibility within a plant is its healing properties.

### **Embryonic entanglement**

Mike: The last thing is to go back to the embryo and the DNA that was in that original cell. So, we followed the whole train of events that resulted in the formation of the zebrafish. But, if we think about it - initially, we have one genome, one set of DNA in that zygote and then we get cell division and the DNA doubles and splits in this beautiful dance involving microtubules and the cytoskeleton and the chromosome comes apart and it goes into two cells, four cells, eight cells, sixteen.

But, we now have evidence [that I have presented] that quantum effects are occurring in biological systems. [Also], Philip has very nicely outlined that entanglement and non-locality [are fundamental]. So, that experiment where you separate the particles that were once together through many miles and you spin one and the other spins - there is instantaneous communication. It's a non-local communication. It completely and utterly violates the rules of faster than light communication. It means that something is happening outside of space time. That's the only way to explain it, without having to get rid of that theory of relativity that says that the speed of light is constant.

So, going back to the embryo, there is [the possibility] of a means of communication between the cells outside of space-time [through entanglement]. One question is why are we so synchronous in our movements? In the way the embryo develops, in the way we move - to dance, to play sports to do all these things? How does the embryo communicate between cells? We're very hung up on the idea of local cause and effect and that is what the history of embryology has been - physical fields

within embryos that [contribute towards making] changes within particular sheets of cells at particular times. Well, here's a mad idea! What if all the DNA is entangled with all the other DNA, because it was always once One? Now it's many, but it's also still One! It's almost like an Indra's web of connection that links all [the cells] together and [perhaps] there's some level of communication [here].

### A Pattern that Permeates

Brian: If we accept what Philip has told us - that things are happening like this, at this level, then it has to be so that it happens at all levels.

Mike: Yes, "As Above, So Below"!

Brian: So, as awesome as it is to see a real example, we shouldn't be surprised at all. We should be looking for this type of pattern, because it's going to be permeating everything.

Mike: Very well said.

Brian: I think it will really hit home when we start looking at it in our human context and how that will radically shift how we think about ourselves and how we interact and our purpose and our function in life. Because [there was] something you said just before about how this whole, about how we have divided the meaning of our own lives and there was a big "Haaaaa" from people because then we really have something to look at and live the experience through things that most people don't think about. I have a quote that came to me a long time ago: *"The world makes perfect sense, but it's up to us to sense it perfectly"*.

Mike: Absolutely right.

Brian: And I often call it the gap between theory [and practice]. Theory is quite simple to get, because you don't have to live it, you can think about it and you can sort of relate - oh yeah, I can see how that can happen - because it's imaginative in a way and then there's practice and embodying what that means. And I call it the gap in between life! How are we going to merge theory and practice? And that's the big question.

Mike: I would look at this from the point of view of the mystics - like the guy who wrote the passage from the cloud of unknowing. The love is the openness and the experience of the connection, the entanglement, the non-locality, the feeling of the whole. And so I think that's what we might get into exploring tomorrow. How can we apply these insights to our own lives? To inhabit this cloud of unknowing as quantum beings, if you want to call us that! So, that we can maximise the possibilities that we want to manifest, to occur, and it's not even some sort of law of attraction type approach [where we are actively imposing our will]. It's more a case of an open-ness, a move towards

wholeness, with the whole informing the parts again - we're kind of back to where we were at the beginning of the week I suppose.

### Extraordinary Ordinarity

Alex: There's one quote that I read last night. It was a quote from Bayo Akomolafe, the man speaking at the Earth Talk last night, and it was a review of the book by Charles Eisenstein<sup>15</sup>: "*The More Beautiful World Our Hearts Tell us is Possible*". It's a beautiful book, and I just love this quote: "*The ordinary is what the extraordinary strives to achieve.*" That's what it is, that moment of collapse, of possibilities becoming, [it] is an act of sacrifice, incredible sacrifice and profound meaning. And we call that the ordinary, but it's what this field of possibilities, which we call the extraordinary, uses all of space time to manifest!

Isa: Space time and beyond!

Fabio: It would be great if we could go into that tomorrow and link that to meaning.

Mike: Well, I think tomorrow we will further explore these issues that might extend from this I suppose.....I don't know if that's what you were thinking?

Philip: Yes. It's like this primary movement that happens. So it's not as if we're here as material Beings or as spiritual Beings that are trying to engineer something, but how do we stay in that space in which this kind of primal activity occurs, this primal activity of making meaning or coherence out of many possibilities, which are written, kind of, through us and how can we state that endeavour. So, we are just trying for a very empty space tomorrow. I don't even know if it's possible to do it. So, we might just sit there saying nothing or you might say "No, this isn't how it works - it's too private to communicate - that space".<sup>16</sup>

Mike: There needs to be space for the authentic arising.

Philip: Yes, because it's like this isn't a theory that we're putting on to biology it's like biology is kind of expanding into a completely different space of what life is telling, what life is saying.

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<sup>15</sup> <http://www.kosmosjournal.org/article/the-more-beautiful-world-our-hearts-know-is-possible/>

<sup>16</sup> At this stage, we were still thinking about creating a space in the classroom - the idea of the silent mini pilgrimage through the woods and to the church had not yet arisen. It turned out that Jamie could not make it, so this contributed to us changing our plans. I emailed Philip later that afternoon from the White Hart pub at Dartington (correspondence at the end of this chapter). I attached a photo I took of a quote by Tagore (related to Philip's metaphor of the other shore), written in stone inside the Dartington Hall gatehouse. I also suggested a silent mini pilgrimage, as I had done a pilgrimage to the church previously on a short course with Rupert Sheldrake. But, this was not in silence and just involved a walk to the church across the fields from the Old Postern.

Jörn: It feels like the move is focusing the attention on the field and I was just reminded of Rupert's morphogenetic fields that contain the forms that contain the possibilities and it's also to get a sense or a feeling of the field of our own lives that is pulling us towards our own unique forms.

Mike: There's a quantum physicist called Amit Goswami who's tried to bring the insights of quantum physics into helping Rupert explain the morphogenetic field theory. His view is that it's still dualistic - there is a field and there is matter, so [how do the two interact?].

Philip: I think we should go into it tomorrow, because if we explain too much it loses its edge, because we're saying that the edge is us. The edge is our journey into meaning, the edge isn't understanding.<sup>17</sup>

Mike: Yes, that's true.

Alex: Thank you!

Mike: You're welcome, it was good!

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<sup>17</sup> And with Philip's words of wisdom, we return to where we started with our unknown 14<sup>th</sup> century monk.

**Email correspondence with Philip**

-----  
from: Mike Wride  
to: Philip Franses  
date: Thu, Oct 22, 2015 at 4:54 PM  
subject: The other shore

I liked the metaphor of the other shore in the teaching... Did you have these words in the Dartington hall gatehouse in mind? Attached! ...

I'm having a pint in the white hart!

Best wishes

Mike

-----  
from: Philip Franses  
to Mike Wride  
date: Thu, Oct 22, 2015 at 4:57 PM  
subject: RE: The other shore

Dear Mike

Sounds like our lecture was carved on stone at the Dartington Gardens as we spoke.

Very apt Present.

Jamie cannot come tomorrow

But hope we can work with the emptiness creatively

Good session again today

Warm regards

Philip

-----  
from: Mike Wride  
to: Philip Franses  
date: Thu, Oct 22, 2015 at 6:38 PM  
subject: Re: The other shore

Hi Philip

Shame Jamie can't make it, but I'm sure it'll be fine.

Would a 'pilgrimage' to the church help tomorrow? Have the students been inside it yet? It's just something that occurred to me..... feel free to ignore...

Best wishes,

Mike

-----

from: Philip Franses

to: Mike Wride

date: Thu, Oct 22, 2015 at 9:05 PM

subject: RE: The other shore

Yes!

# Day 5: Friday

## Chapter 9

### Trust in process

#### Introduction

Alex review of the week: I would describe this week as a clearing of the mind. Rare, this feeling just after not knowing, when you come out of a profound teaching experience that is so vast and so evolutionary that all the questions you have, create a symphony, and that symphony forms a silence, that is just waiting. So I feel in that precious stage of what's next. This week has been very special. Yesterday and the day before, it just all lined up, very perfect actually.

Some really useful reflections in there, like trust, and that which is familiar and completion. I'd like to relate this week to last week. This week illustrated perfectly what we had been talking about last week.

#### Field of trust

*At some point on Tuesday morning, I made the unfamiliar step of*

*"you know what I really have to trust Mike, and Mike has to trust me."*

*And as soon as I made that commitment, things began to get clear... [from preface, recapping the story of the week]*

The field notion of Maxwell that I was planning to teach suddenly then appeared to me in a quite novel way. We can see Maxwell's equations in two ways.

Either the fields are descriptions of reality, explanations of things that exist in space, for which the mathematical equations tell us how they behave in time.

Or the equations are the ground of what is possible that in actuality delivers the world of existence in the form of light. This latter view was centrally relevant to how the zygote was able to direct all its material activity into a single form. The fields in the second view are not something we have to pin down as existing. They are the ground of possibility (of identity and relation) that in their combining together, deliver the world as light. The field is the grid of that wanting to be born through itself.

Tuesday we put a lot of effort of going into the meaning of what we were trying to do. Then, instead of going into the biology Mike did a card game about meaning. So we had both seemingly gone off the track of what our individual content was going to be. We entered a whole new terrain, for we had entered the pattern of letting this thing develop.

#### Living the story

On the Wednesday, the magical day, we started by Mike laying out of the cards of the embryo. Because we had already seen the cards of the story, and we had worked out the story's meaning, the cards of the embryo immediately took on a significance, that we were not just looking at things, and

labels, even though we went through all the labels of the different processes, but we were looking at a process of meaning. This was very startling. For in biology we are trained to look at it as steps without underlying message. We were looking at the embryo journey as a meaning, because of the card game. The transformation was already beginning to happen that biology is not just about knowledge as the only way to understand life. Life was something about *us*, just like we recognised the story in the meaning. Biology was beginning to come alive, for we were seeing the development of the cell as something to do with meaning.

Then I was going to speak about Einstein and relativity. Surely this would be another obscure leap. But once I started talking about space, time and Einstein's understanding of the universe through light, then it was clear that the embryo beautifully illustrated this view of space and time. You did not need space and time as abstract principles to understand the journey of meaning. In fact the rhythm of that journey of meaning through the embryo enabled you to talk about space and time. The rhythm allowed one to identify points in the cycle that allowed one to distinguish periods of time. The growing of the embryo created its own boundary in space. You did not need to measure space.

Einstein was not just talking about the universe, but also about the embryo, and its journey of meaning. The card game had started with the universe and ended with the rooster. And we were going even further down into the genetics of the rooster and its embryonic development. So as we were talking, more and more things aligned, the micro, the macro and the human in between.

We were not talking about something, either the cell and how it developed into the embryo, or the universe and how we now understand it as a dynamic developing organism, you could say. But we were talking about an underlying process that had many forms, as a journey into meaning. Instead of life being put into this compartment called biology, with this text book, dissecting it to meaninglessness, life had become this model that was true about everything, of all human development, of the universe. We needed our relation to the living journey of the organism, in order to put into perspective our own journeys, and our own relation to the universe. Life had popped out of this dull biology book, and it was becoming a pointer to us, something real. As Alex said we recognised it. We recognised something that was true of every embryo, of the universe, of ourselves on journeys. By going into the relationship of physics and biology, of that relationship of trust, we found this fractal pattern, true at many levels of scale, the cell, the organism, ourselves, the universe. We recognised the pattern and how we fitted in it. It was very reassuring and grounded. I felt it. We were not talking about something abstract, we were talking about life. There was not this division of science and spirit, biology and physics, meaning and matter. I felt clarity in myself in the apprehending of that.

Isa: Choices always have to be made.

What is life is connected to meaning. We use life as if it is something we have almost understood. Life is just another noun. But in that moment we go through the doorway of that trust into this

space where we feel life as a surrender to trust and relationship, life appears as a quality, with a specific direction towards meaning, to completion.

You are in the swing of what the journey can become, nothing can stop you, you are in that rhythm of where the journey is going. Life has the same feel, when we experience it, as on Wednesday. The fractal nature is experienced inherently. When you bring together the universe and the zebra fish embryo, instead of it being a model something becomes clarified and revealed. We entered this place of relationship and trust, and what happened had a completely different quality to it, than if first we had gone into biology and then physics, which would have required a 3 year undergraduate degree. But because we allowed a relationship between the two everything became clear. We could go through relativity, through space time, in a completely simple way that people could relate to it, as something recognisable. It was an emergent quality. We had not constructed it artificially.

Thais: And in that way we could go into it without being reductionist or simplistic.

Life itself has this quality of meaning, a quality in itself. Life is not a static thing. It has this quality of meaning and direction.

Diana: I am seeing a paradox of the relationship of maximum freedom of the parts and maximum expression of the coherence of the whole. For coherence to be expressed, the parts need to be free, but once free coherence is achieved, only if there is only one option.

When you are in that state of Monday wondering how to do the class, it is very easy to trust, because in a way you don't have any option. You trust. That trust brings you into coherence. And trust gives absolute freedom to the other. And it is a difficult step to make. For in giving freedom to the other, you are giving them total freedom. Having made that step, the freedom fulfils itself in some kind of arrival. The tension goes and the uncertainty can be let go.

Life is continually at this point of needing to maximise the freedom of all its possibilities, it is continually trying to do something new, it is continually trying to extend what is possible through its parts, and yet out of all those possibilities, it still brings it back to this central movement, central direction, it is still in that threshold state of trying to travel to somewhere. Life is always at the edge of freedom and meaning. But it is also true that you need to be on that edge really to trust. It is because you are on that edge that you don't know where you are going that you are able to trust in that fundamental way. A process can take place between freedom and coherence, between emptiness and fullness, between letting go of the finite, and embracing the infinite. It allows both to happen as a pattern. It is not rooted in one or the other. It is in between dimensions.

[battery runs out]

[new recording]

Mike: One restraint for me was letting go of the power point. But that letting go frees up the emergence.

Philip: The natural experience of life is the directing of meaning towards us. That feeling has everything in it. It is not that it is leaving some things behind. Everything is in that quality, that movement.

Alex: I wrote down on Monday the sentence 'If you cannot bear the tension of incomplete knowledge, the work we do here is meaningless.' This holds true at so many levels of scale. That is the grand challenge.

Philip: Just to recognise something.

Mike: I had that experience on the Wednesday morning. You went first every other day. I couldn't see how to link the card game to embryos. The year before we had done the embryo card game, and it worked and there was a learning experience involved. But there was a feeling in me that there was something different required, which was why I brought the other cards. But I hadn't appreciated quite how the cards would feed into the embryo story. So Wednesday morning I saw you [Philip] in the corridor, and said who should go first. Philip said you go first. We didn't have a discussion about it. It felt right. That fed into the circle of cards and the recognition of the relationship between physics and biology. And you had your name in the card circle. And this had import or significance because in the zoom card game we realised that there was a point where the people on the island were the human level. But Philip when you realised the piece of paper with your name on, which was not planned but that had meaning.

Isa: Did you put it into place?

Philip: No. I had been given the badge the day before to wear at an open day and it would not stick and so had fallen off. I lost it and didn't know where it was.

Isa: But it was in the perfect place.

Philip: Yes. Suddenly when we were laying out the cards, someone said Philip is in the circle.

Isa: It was exactly at the turning point of the development of the embryo.

Philip: It was like a little mark saying this is where you need to come in, later.

Mike: There is something ritualistic aspect of laying the cards out. I had a whole bunch of cards and I had to put them in that circle. You [Thais] were just lying in that circle, like an art installation, sleeping beauty in the middle. Coiled up like an embryo

Isa: Is that making practical complexity?

Yes.

### Meeting the Shore

On the Thursday we went full circle, we went back to quantum theory, which is how wholeness comes into being at that elementary shore, of the particle. And showing how that is also true of quantum biology. There is this other shore, which is not where the elementary gets born, where the everyday reveals itself with meaning. Mike sent this great inscription from Dartington

Mike: It is in the entrance gate as you go in.

Evelyn: On the wall outside the Barn cinema

Stephan: Tagore wrote that

Mike: Philip had used the shore of meaning Tagore quote:

“Here rolls the sea, and even here lies the other shore waiting to be reached, yes here is the everlasting present, not distant not anywhere else.”

It is not something far away, when you open up in trust to the world, what you experience, what was the last line, maybe read the whole thing again.

Mike: When we talked about the quantum biology yesterday, [despite the ongoing gong problem] we considered the implications of quantum biology, quantum effects for us, in our lives, in our bodies. We can inhabit this cloud of unknowing, because the shore is here, “even here lies the other shore.” Within the zygote there is a feeling of knowing, something is immanent, without knowing what it would become, whether it would be me or you. It had an inner drive to become, to reach the other shore.

I love these synchronicities, because it shows you the universe is about meaning. You could end up finding meaning in everything. There are things that do have this feeling that comes into you where there is an immediate feeling that there is meaning here.

### Close at hand

It is not distant. What we experience is not something far away. When you open up in trust, what you experience, when we enter into that meaning and touch the other shore, then that is the real. The real is not the world of separation.

Alex: What is that quote of light in the first chapter of your book? We have to change our understanding of light so that it becomes more living, more dynamic. He talks of the conceptual qualities of light, to allow it to become more living, more dynamic.

Arthur Zajonc:

'Sense objects must possess sharply defined attributes. Light, quantum mechanically considered, need not. Its attributes are more holistic; in general they exist in inseparable or entangled combinations, at least until the moment of measurement, whatever that is.

What are the primary qualities of light that vouchsafe its unambiguous existence? The extraordinary response given by quantum realism is that there are none. Light, as an enduring, well-defined, local entity vanishes. In its place a subtle, entangled object evolves, holding all four of its quantum qualities suspended within itself, until the fatal act of measurement.' (*Zajonc*, p.315)

Alex : There is something magical about that.

Philip: I have never seen it in that way. He is not talking about light as some experimental thing [a list of qualities that light possesses], but light [in its unique quality of arising to be itself]

Alex: Yes something whole, irreducible.

Stephan: Four is the number of wholeness, all mandalas are based on the number 4.

Mike: I am intrigued by the term [fatal act of measurement.] In the dynamic of the teaching, we have tried to avoid measurement, we have been engaged in the process of trust and flow within this cloud, but tending to measure something or state something or fix it, pulls it down. We need to focus on communication rather than measurement.

Stephan: Is measurement an observation or can it just mean meeting something?

Thais: We did question what was being measured. The measurement itself affects the outcome.

Philip: Bohr defused the whole question what is the cloud of becoming, by saying physics only had to deal with what arose in measurement, and what was there before was only a mathematical reality. This is very hard to disentangle. We like to exist according to other people's expectations of us. That is a completely different way of being. We become the image other people see of us. Bohr identified the world in how measurement fulfils the expectation of what we think is going to be there. Instead of dealing with the cloud of unknowing, you defuse it, into playing this game by making measurement the only actuality. That was the concealment Bohr introduced into quantum theory. Instead of revealing wholeness, it took us away from wholeness.

Evelyn: In relationship in the falling of love there is a sense of great openness and all possibilities and nothing fixed. As the relationship goes on, it takes a different form and then it becomes fixed. And then it can become difficult to see all the possibilities in the other person, and they in you. Something gets fixed and it is not alive any more. Falling in love is being open to all the possibilities.

Mike: The measurement issue simplifies it so much, because it does not bring in any concept of communication - in terms of relationship, verbal communication or unstated communication. How

might we think about communication, instead of measurement, in terms of electrons and clouds of unknowing?

Alex: The opposite of trust is expectation.

Isa: You better write all this in your dissertation.

Mike: And I was thinking about that because how well you all communicated in that card game. For you could say the meaning emerged in an act of measurement of turning the cards over. But actually all the communication preceded that.

Diana: If you act with expectations, you are the observer for it very much affects the outcome.

We create the meaning. We communicate different messages.

In the card game, there was the cloud of unknowing in the beginning and then there was tons of communication. And that was that trust again. For the only way forward is trust and communication. There is no expectation any more. There was expectation before.

Thais [indicating window]:

Karina: There is a moth needing to get out

Alex: It is a butterfly!

Stephan: It is a tortoise shell

Mike: That is a symbolic thing

Philip: Yes we need to go out

Stephan: A communication of the psyche!

Yes, we are going to go out. After a cup of tea. For a pilgrimage.

Mike: Silently

Thais: We did communicate and that brought the meaning forth. If we had tried to measure it first we would not have come to the meaning.

*[Mike: It was tortoiseshell butterfly! And we were talking about communication! So, the butterfly appears to communicate some meaning...And the butterfly appears to show us that we should stop and go on the pilgrimage - yes! But there was more to it in terms of meaning. I saw this as a hugely symbolic and meaningful synchronistic and magical happening right at the end of the teaching. If he's been there hiding in the room, he waited until just that moment to appear to us! And Stephan mentioned the Jungian meaning (in terms of the butterfly archetype). And the butterfly also*

*epitomises transformation. To me the butterfly was the physical manifestation of everything we were teaching and learning!]*

*[Philip: In quantum processes, there exists an associated potential for event, which represent together a characteristic of being wholly seen. In physics, a pattern of events is foreseen, as inherent to the nature of measurement. It is this that gives physics an apparently defining role in creation, for the order it foresees of what can be measured becomes the pattern of how existence shows itself.*

*In biology, quantum processes live in the recognition of the boundary of a distinction of a whole identity. The events are at the shore of meaning rather than the shore of matter. The wholeness to which the events relate is not a mathematical abstraction, but a living expression of meaning and identity. In other words, the potential of events is identified in relation to a whole identity whose existence is only viable through the defining capability of its existence. The event is recognised as consequence (rather than foreseeing the act of measurement as physics) of the whole identity that its capability enables.*

*This suggests that each leap in evolution has a quantum signature. Existence names itself without exactly defining the nature of the step through which its identity is realised. The process of energy exchange with the environment is elemental in defining the identity of the bacteria. The bacteria could continue to work with different energetic exchanges with the environment, as resolutions of the open nature of the form of its identity. Only when many such variations of existence had been explored did life leap again incorporating four basic bacterial existences into the new nucleated cell.*

*Photosynthesis as an example, derives its quantum nature from being at the boundary of what establishes the organism as a viable existence of life. The nature of photosynthetic transfer of energy between molecules is shown as having a quantum beat. The photosynthesis exists at the boundary of what makes the organism distinct. The events are not in space time, but have another quality of association that together lives the boundary of differentiation of the organism as life, from the dead matter of what is around.*

*The shore of measurement of fundamental existence that physics studies identifies that which has form at the point where it appears out of nothingness. This is classical quantum theory. In biology the threshold point that is crossed, is at the other end of things, how possibility marks the boundary of distinction of the viability of singular life. The quantum events associate together in their ability to collectively mark the boundary of whole organisation existing as a unity over and above all the component activity of its constitution. These quantum events mark the boundary, which determines how a new level of existence forms itself on top of an old collection of independent activity. The boundary is made by these threshold events that together have the characteristic of sealing identity in one definition of life. A cell is a collection of proteins, or organ a working of cells, or organism a fitting of organs etc.*

*Moving through the many orders of life, we are as Leibniz, bound to realise the need for God, as the expression of the boundary definition of mystic events, drawing the test of a lived unity. God is the*

*string of miracles that gives whole character to a seeking for definition in life. Somehow religion has contested the existence of God with science, as if they are battling on the same ground for the mind of reason and the soul of congregations. Anything which argues or attests to God is not God! God exists in those boundary events, which uniquely declare identity to life, in the most humble way as the exit of a butterfly and the significance it shows in what was to come].*

## Afterword: Reflections on a Silent Pilgrimage

We gather in a circle outside the College, linking arms. One rule from now on – silence. How will we find freedom and coherence in the silence? Is ‘science’ to be found within this ‘silence’? The potential of the silence for a study of self-metamorphosis, like the butterfly, and the emergence of us from the chrysalis into the light of new meaning at the end? We would see....

We lead the way through the North Woods with a string of students behind us each walking in their own time, some barefoot, but all silent. We move mindfully, listening to the wind rustling the trees. There is this freedom now coming to us within the silence. We continue on, reflecting on the week in the classroom, past the rooster and his hens (more meaning; there was a rooster depicted in the card game). We move on to the church – St Mary’s. I [Mike] circle the church three times, some students follow, others climb trees, but we eventually all enter the silence of this sacred space epitomising meaning in matter. Wholeness, health, holiness – everything encapsulated in this place, linking to the meaning of the teaching. We leave one by one and form a long chain back to the College. Once there, we again form a circle, linking arms.

We need to close this experience off with something meaningful, spontaneous, creative. The idea came through me as I left the church. I enter the circle, acknowledging each member of the ring, each cell in this organism. I leave the circle and walk around the outside. The human circle now became a sacred space, a human church. I then re-join the circle. Each student entering one at a time, looking each other in the eye, into the depths of each soul, deep into the sacred presence of the other, each gaze imbued with meaning, each one still developing, still growing, still relating, still communicating even in the silence....

There is silence, but also excitement - reflecting on what has happened during this week. How we had gone from ‘nothing’ to ‘no-thing’ to ‘know things’ along with the students! Difficult to put into words. We knew that we were the same, Mike and Philip, but we were also different - differentiated. The same, but different. The week of teaching was incredibly profound. We had trust in the freedom of the parts and the coherence of the whole, just as Brian had suggested, and we had emerged transformed by the experience.

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