

HOLISTIC APPROACH IN BIOLOGY AND NEUROSCIENCE, FINALE DEBATE

Proceedings

LUDOVICO GALLEN: This is very good work done, thank you very much. I think that the main problem of Teilhard at present curiously is that his works are not yet very well known among many people who speak about Teilhard. We had a strong debate in the Rome meeting on Darwin in 2009 about this. Because I went proposing many of the aspects of the Teilhard's scientific work I referred to yesterday. But they are not yet well-known, not only the scientific part of the public papers, but also from the theologian and philosopher's perspective. So I think we have in Teilhard two main tasks for the future. The first, to work on his paper and to know now what exactly was in his mind, if it is possible of course, because mind is a quantum situation.

LUDOVICO GALLEN: But you know that as I said yesterday, many of his papers were not published. So they are published posthumously and they are not correctly referring his thinking. But we have now a lot of letters of the pages of diary – a lot of things about him. And I think it's correct, the position of the late Cardinal Delback, that many people speaking against Teilhard did it only after a lecture of a few pages and a very quick analysis of a few pages. We must know very well Teilhard and then the answer to these questions. Because they are actually very good questions. For us to work with and to have again Teilhard back, both on the side of science, but mainly on the side of theology. I think that for the future, at least Roman Catholic theology has to confront again, with the perspective opened by Teilhard, which is the perspective of the [unclear] with science. So thank you very much for the last questions.

MIROSLAW KARABA: So this is a question for Ludovico Galleni concerned Teilhard. When you've spoken about internal factors of evolution, so my question is, what is the difference between Teilhard's conception and the Intelligent Design (ID) concept? I ask because there are many similarities for me. Thank you.

LUDOVICO GALLEN: This is another question for the agenda for the future. The internal factors mean that when you reach a solution then the next steps are canalised or channelized. So you have not have the work of mutation and natural selection, but different mechanisms related to the organisation of one level of animal form. So you find mammals and then you have an evolution of mammals in Australia and you have an evolution of mammals on the other continents. Anyway, they are following the same morphological patterns, because they have to follow, what was the first solution of mammals. This is what I mean with the term internal. The intelligent design is out of this, because the intelligent design is, in my opinion, bad science, bad philosophy and bad theology.

And I am trying to show that, on the contrary, Teilhard was a good scientist and good philosopher and good theologian, I hope. But at least a good scientist. What is for Teilhard, is the idea perhaps, but this is not intelligent design, that if there is some kind of moving towards of live matter toward complexity and live toward complexity in evolution. This moving toward is useful to theology because it could be reported to the general moving

toward of the universe, to be prepared for the second coming of Christ, which is not the only point of Teilhard. And on the other side, this moving towards must present some aspect which could be a good proposal for a scientific research programme. But I told you yesterday, my opinion. This is the general way theoretical biology occurring in science is made.

They are made not only of observation of experiments, but also in their ideas of the scientists. In this way I presented this model in some paper as the correct model of interrelation between science and theology. The scientist is looking back also to his and her ideas on philosophy and theology. He constructs his theory and then this theory must follow a way to be demonstrated by the instruments of science by observation and experiments. But in my opinion the position of Teilhard is good. Of course in my opinion a good example of interrelations between science and theology which is not intelligent design, which is in my opinion a bad example of interrelation of science and theology.

MODERATOR: Is there something unclear about Teilhard's writing that allows it to be interpreted. People from intelligent design side can go, yes, he's kind of our side. People who are opposed to it, people who think there are links with Lovelock and the Gaia hypothesis can go, yes, he's backing us as well?

LUDOVICO GALLEN: Yes, we are back to the main problem. I think that, at present, Teilhard is not yet very well known or very well discussed. You know that when there was the explosion of new age, Teilhard was considered one of the forerunners of new age I believe nothing of this. Teilhard was a very serious thinker and scientist – completely different from new age. I know of the opinion of Peter Medawar, but I disagree completely with Medawar. I am not the Nobel Prize winner. Anyway, Nobel Prize winners said not very good things when they spoke of aspects of cultures which they don't know at all. The problem of Teilhard again is that he was not allowed to publish during his life, his books. So there is not the clarity which is obtained then, to the free discussions.

We are back to the possibility of free discussion inside the church, now we are open to free discussion. We meet via free discussion and we come back to Teilhard, to present what he actually said and not our interpretation. So my idea is that he is very, very far away from intelligent design. Proof in my opinion is his links with the idea and teaching of John Henry Newman, *New Essence* or something like that, of the German Catholic Church. And Newman was clearly against natural theology of theory, but which some sentences which are very useful also today, against intelligent design.

STUART HAMEROFF: I don't understand the fine points of the distinctions between intelligent design and Teilhard. I know that intelligent design got a lot of bad press. But what I want to say is that the Orch-Or model and specifically Penrose Non Computable Effects Guiding our Conscious Choices can also be applied to mutations and DNA, thus guiding evolution. So it could be that the same non computable influences, which might be theological, might be coming from the future, might be towards some goal. But in any case, some guidance from the universe you could say works at the level of DNA also.

And I have written an appendix on one of my papers applying to that. One thing I read about intelligent design which obviously had some problems; I used microtubules as an example of something that would be hard to explain how it evolved spontaneously. Because you have this individual protein and the individual protein by itself has no utility at all. It's only when it's in a complex microtubule. So how would biology, nature, whatever, know to evolve tubuline and the individual protein when its purpose would be to be in microtubule it's like evolving a single brick when your goal is to build a skyscraper or a

big building. So in any case, I think Penrose's non-computability and Orch-Or can be applied to mutations and evolution and give a picture of something like Teilhard, yes.

STUART HAMEROFF: Yes I don't know. This was cited by one of the intelligent design authors who got criticised for many other things, but I thought that in particular was a good argument. You tell me, why would nature evolve a single protein whose purpose is to be part of a complex? I mean there's no immediate feedback for survival and benefit until you have the whole protein the whole microtubule complex.

GIORGIO INNOCENTI: Yesterday I was trying to say that one of the problems with evolution is trying to understand why we have... we see that practically identical or very similar morphological types of animals have evolved separately among the placental and the marsupial species. And so that means that there was some kind of strong directedness, or if you want canalisation in evolution. And I think that the main effort that we have to make, as empirical scientists, is to understand at least at the theoretical level. But the theoretical level based on strong empirical sub straight, how this has been possible. In my abstract I have quoted a paper by Gerhard and Kitchner and the other one I believe at Berkley. And the paper is, *The Theory of Facilitated Valuation*. It was published in PNAS 2007.

And then there have been more follows up in more recent literature by the two others who also have published a handbook on evolution. Essentially what this paper and this theory try to achieve is to make us understand how canalisation is possible. And the canalisation is possible on the basis of a number of factors that they really line out. One is that the evolution. It's possible by evolution to create meaningful phenotypes when the mutation is affecting some higher order genes, so genes which orchestrate other sets of genes in a coherent way. In the example which was given yesterday of the *Drosophila* origination and which, for some interesting reason, at least to me, was the segmental organisation of a very early living species. What is happening in the *Drosophila* is that it is possible to mutate a segment which produces abdomen into a segment which produces wings, just because one is mutating the master genes which coordinate the appearance of wings in a segment.

So this is one aspect, is affecting master genes. One can generate phenotypes which have some intrinsic coherence, so logics and also from the morphological and functional logic. The other one is that many of the living beings are organised in modules and so the modularity of the organisation of the living phenotype and it has some way of kind of constraining certain valuations which are possible to obtain just by random mutation of genes or by the duplication of genes. Another mechanism which is invoked and on which I've worked personally is the fact that during development there is usually exuberant production of a certain number of elements, one if for example the cells. The cells are produced in excess in development and then part of them will be deleted by some kind of, people like to call programmed, I prefer to call it say meaningful and on elimination. And the same is true for actions that are also produced in excess.

So and now I'm not sure that I remember all [unclear] that Gerhardt and Kiesner are pointing out in their theory of facilitator valuation. But these are just some examples where we don't need to imply any intelligent design. We don't need to imply creators or anything. We just imply... We need to imply a certain intrinsic logics of the living matter and of the way the living matter develops. And that is maybe another element; in connection with the environment where there may be some kind of feedback from the environment to the expression of genomic properties. Perhaps in the direction of solving the riddle of why, when our molecular biology's start mutating one gene here and there, usually they

make some kind of animals which does not survive well and is pretty much screwed up. Well, they have not simply hit the right genes, I'm afraid.

They are very often interested in a particular gene and how does it function and they do not really sit in the right genes. When they do, they can generate, for example, in the regionalisation cortex, they can generate Telencephalon. Where the front part of the Telencephalon or the back part of the Telencephalon can expand in different manner. So you can increase the frontal part with sensory cortex, you can decrease the prosterial part and so on and so forth, which is already going in the direction of some kind of regularity and meaningfulness of the whole operation.

Coming back to the Teilhard's question. We should mention that the first evolutionary thought, philosophically speaking, in the west is Hegel's *Phenomenology of the Spirit*. Because in this work, Hegel is telling us how a proto-human starts, how consciousness starts and how in the end we reach a final state which of course from Hegel is «The Perfect State». But we don't need to consider the «The Perfect State» as the final state. The Persian state can be the omega point. So in this sense, what Teilhard's is doing is playing the Segal tune with biological overtones. In fact, in the 19th century there are plenty of, so to speak, Teilhardian themes. For instance, in 1844 an anonymously Scottish man, Robert Chambers, published *The Natural History of Creation*.

And in there is again the Hegelian theme with biological overtones. Yourself you mentioned George Jackson Mivart's, He was the only person Darwin hated profoundly you know. Mivart published in 1871 the genesis of species, the same year Darwin published the origin of man. And the impact of this work was so phenomenal on Darwin's thought that Darwin had to add an extra chapter to the origin of species, just as to answer Mivart. And then of course we have Darwin's only disciple, George Romanes, who also played in the finalistic theme in Teilhard. So in essence, Teilhard is the French response to the Hegelian challenge which the English version is the natural theology. And in this sense I think we should not see Teilhard after the historical context – a very rich historical context.

LUDOVICO GALLEN: Yes. Who is back here to speak about Teilhard? Yes this idea is the idea of progress which is the eliministic of progress, of humanity moving towards a best situation is also the main physical idea of Lamarck. So I think that this is the true influence of Lamarck on Teilhard and of the French scientific and philosophic milieu. You know that the French had some problems with Darwin. The palaeontological science had some problems with Darwinism and Teilhard was French and a palaeontologist. So these were some of the problems. It's correct to see this idea of progress inside these general ideas of progress which were reported in evolution for the first time, by Lamarck. I think on the back, that the idea of moving towards the second coming of Christ is on the contrary, a strong idea based on some theological hints from the New Testament. And this is one of the works Cardinal De Lubac did to show how Teilhard was strongly rooted in Christian theology. This is the difference between Teilhard and Segal, I think.

GIORGIO INNOCENTI: I wanted to thank Javier for this paper that he gave. Because this paper is so full of questions and I really think that these questions will be with us and will help us to continue to do some thinking about what we should do. Having said that, I would like to give you a small introduction to the history of neuroscience which will then connect perhaps to quantum mechanics. It has gone like this: that from very early on there has been an attempt of mapping brain functions on to some of the logical aspects of the brain. And we have gone for several centuries with the idea that functions were mapped in the ventricles and there were three or four functions, one of which was intelligence, the other one was memory, etc.

And each of these functions was sitting in a different ventricle. And this went for many years, until the sort of sixteenth century, or so, and supported by the intellectual power of the church. And then people started becoming concerned about what was around the ventricles after all. And so we came into studying what is the structure of the neurological, of the brain parenchyma. And of course here, making a quick jump, we come to this tremendous new anatomist, Ramón y Cajal, who gave to us essentially the morphological description of different cell types in the brain and who established the cellular, the neuronal doctrine of the brain, meaning the brain consists of units and these units are functional and metabolic units and developmental units. And these are the neurons. Which was actually an application of Swann's cell theory to the brain.

So we have now a morphological description of the brain. Some years later, by recording activity in nerve fibres, the British school came up to discover that the brain was actually functioning with electrical signals. And so we had for many years an electrical description of the brain, which gave us a lot of information. Much more recently, I would say some perhaps 20 years ago, when my colleagues at Karolinska Institutet succeeded in charting new transmitters and visualising new transmitter and neurons and discovered the pathways with catecholamines, for example. Then we started having a biochemical description of the brain. And this molecular description of the brain has expanded into characterisation of the receptor proteins, channel proteins and so forth. So it is only to be expected, that at some point we will have quantum, or physical, aspects of physics incorporated into the view of the brain.

This is not to mean that there are two different descriptions to the brain; one based on the classical physics and the longstanding observations on neuron organisation, circuits, etc, and the other one having to do with quantum physics. I think these two will collapse into each other, but it is also fair to say that at this moment the empirical basis for the quantum physics in the brain is extremely slim or perhaps even non-existent. You know, where is the charting of microtubule states onto the state of the neuron? Where is the charting of the state of the neuron based on microtubules on the state of networks and so forth? But I'm sure that there will be more quantum phenomena discovered in synapses, etc. So we wait for that and we will see what comes. But I don't think it is necessary to make now two fields of investigations if they were separate fields, one of which is actually a big elephant, which is the classical description of the nervous system structure and function and the other one is a nice interesting little creature which is going perhaps to grow in the coming years, but it is not there yet.

I wanted to say two things. Gamma oscillations have been mentioned very much in this context; they're not necessarily a manifestation of consciousness. And I've been with gamma oscillations for quite some time, because one of my friends, Wolf Singer, has been very popular in pushing this notion. And gamma oscillation has been used by him as the solution of the binding problem; meaning, in order to make sensible reality, our brain, which is dissecting reality in different components, visual, somato-sensory, auditory, etc, is using gamma oscillations to bind them. That's a possibility. The other possibility is that gamma oscillations simply reflect attention and there we have the problem of how attention relates to consciousness. So I would be prudent at this stage to say gamma oscillations are consciousness. Maybe they are and maybe they're not.

Final point; Stuart in his very nice and provocative presentation yesterday was talking about the near death experience. Near death experience, there is a lot of literature on it. These are patients who have ischemic problems, which are almost dead, but then they resuscitate. And when they resuscitate they describe the kind of things that he has described. They have seen light in a tunnel. They move toward the end of this light.

Sometimes they have the feeling that they are flying above their body so they look down on their body from the ceiling of the room where they are. Sometimes they even walk out of the hospital, they go out to the street, they meet somebody and they come back because they are resuscitated. What is that? This is the way I think the brain is trying to make a story when it begins to feel that the body is no longer there.

It is not trivial for a brain to understand that it is in one body. Me, brain, this is my body. I interact with it. It's a problem which has to be solved in development. And in children sometimes the sensation of excorporation is a natural phenomenon; then it disappears with age. I have a colleague at Karolinska, Henry Kerson, who has succeeded in creating extra-corporeal sensations in people by using artificial reality. So you can say you can fool the soul to believe that it's actually a puppet, which is in the artificial reality world. But the more, I think, parsimonious explanation is that we have to adapt; the brain has to adapt to the body and these adaptations sometimes break down and then the brain constructs, essentially, hallucinations. And it is not clear to me, Stuart, how this relates really to quantum mechanics and the origin of the universe.

STUART HAMEROFF: Let me take your first point. So we started thinking of consciousness being in the ventricles or the brain function being in the ventricles. And then we realised there's parenchyma, neurons and glia, which you didn't mention, which is still somewhat mysterious. And then your point was, eventually we're going to get to quantum. And I appreciate that. You skipped a step I think in that, going intra-cellular in the microtubules and just even classical processing in microtubules.

I spent 20 years working on the idea of information processing in microtubules relevant to cognition and consciousness. I jumped to the quantum idea because one day somebody said to me, how would that explain consciousness? It was reductionism, it was materialism, it was ultra reductionism and I ran into the hard problems. So even if there's more computation at the level of microtubules supporting synaptic function and neural function, it couldn't explain consciousness.

Having said that, if it turns out to be true that microtubules process information in a way like what we said I'd be very happy and that would be, I would say, successful for me in terms of what I did, because I pushed that idea for 20 years but I didn't think it was good enough and it wasn't the whole story. So I would include the microtubule classical information processing in your step-wise expansion of what we consider the nervous system to do in the brain. I remember the last point, but you had another point in there.

STUART HAMEROFF: Gamma, yes; I know Wolf Singer, not as well as you do, but I've heard him speak many times and I think you need you don't absolutely need gamma because by Orch-OR you can have any kind of. A worm might have a conscious moment once every five minutes, so it doesn't have gamma. But I think we have evolved so that we can have a conscious moment 40 times a second, or if we're in an altered state, maybe 80, 100, maybe even 1,000 times a second. So gamma isn't consciousness per se. It supports consciousness. It's a timing of consciousness. It's an artefact almost of consciousness or something like that. So it needn't be. Maybe at some time we're only having 12, we're down on the alpha range or something like that, conscious moments per second, and sometimes we're at 100.

The difference between my view of gamma and Wolf Singer's view is that he maintains, and most people do that... I shouldn't say most people, but a lot of people maintain that it's due to external dendritic chemical synaptic activity with feedback. Whereas the gap junctions I think are important and when I proposed gap junctions in our model because I wanted a way to tunnel quantum effects between cells and gap junctions were very

convenient to do that. So I proposed, in 1998, that gap junctions were necessary for the neural correlate of consciousness. And it wasn't until a few years later that people started to realise that gap junctions mediate gamma synchrony.

That was a prediction based on the Orch-OR model, which turned out to be true; didn't prove Orch-OR, but it was certainly consistent with it and supportive of it. And I think, as far as binding, what you need is not just the temporal synchrony, but the physical synchrony of the gap junctions, because it makes... it goes back to Golgi, as we were talking about the other day. Before Cajal, Golgi said that the brain was a tangled web of uninterrupted fibres, like a ball of yarn. And then Cajal found the gaps and it was synapses and said, no they're discrete cells; the Swann's theory, as you said. So the gap junction's a throwback to Golgi who had a sensation, but it's a localised sensation. And I think the binding is not only temporal, but also physical, inside the neurons and glia that are connected by gap junctions.

The final point about near death and out of body experience: I know Henry Kerson, I've heard him speak several times and he'll be at the Stockholm conference, and his out of body experience... in fact I hope to have him in the session with the other types of discussion. It's not really the same. It doesn't have the white light; it doesn't have the tunnel; doesn't have the dead relatives and things like that. But it is an illusion and it makes you wonder. But I don't think it's the same thing and, talking to him personally, he doesn't really claim that it explains near death and out of body experience. None the less, it's an important point. I think it's plausible, possible that the soul can actually leave the body at the time of death or near death, because consciousness is happening normally, in space-time geometry, between the ears. But when the coherence is lost, it's possible to dissipate and be in the universe at large. So I think it's... I'm not claiming any evidence for this, but I'm claiming a plausibility argument that could explain it.

MODERATOR: My favourite bit of research on out of body experiences was done, I think, by Chris French in London and they had all these patients reporting on looking down on their bodies. So they had the idea of leaving little messages on the top of the cupboards around their beds, to see if they could read their messages. And mostly no, but there were a couple who seemed to come back with something remarkably close to what the messages were, as well.

KHALIL CHAMCHAM: We have talked a great deal about consciousness and everybody's agreed that we don't know what consciousness is. I just want to point out that a lot of the evidence that is being produced for us is actually evidence of markers of consciousness. In other words, we are looking at sort of secondary things which we interpret as pointing towards consciousness. One of the questions that arise for me about this connection between the neural picture and the quantum picture is what we then mean by states of consciousness, which is a phrase that's been used a lot. Giorgio has said during the course of his presentation that one of the problems we face is mapping states of consciousness onto the mind. I'm not sure of state of consciousness means when you come to the quantum and I'm not sure how these things tie together. I just find that a very confusing idea.

And I think until we can sort those kinds of things out we're not going to move much beyond some of the discussion that we're having at the moment. Because all we can do is point towards these things and then interpret them. We need to remember that what we're doing is interpreting.

STUART HAMEROFF: By state I assume you mean something like the content of consciousness. Or do you mean different modes. Because you can look at it as, okay one

state of consciousness is that I'm jogging and I'm running and so I'm just running or I'm playing basketball or something like that. Or a state could be, I'm relaxed, I'm in a different mode. But I think really state implies the content of consciousness at any one moment. So you want to map that. So right now I'm conscious of this scene. I see all of you in my mind. I have this picture; I'm trying to think of what I'm going to say next. So I have a combination of a visual scene and planning ahead and analysing what you said and responding to it. So I think my state of consciousness is a mixture of several modes of observing, of planning of speaking.

And so the state is the content of consciousness at any one time. So we have the same issue, whether we think of the brain at the level of neurons which pattern of neurons are active or firing or synchronised, correlating with the given content of the this visual scene for example. But that also can map down to the micro tubular level and the quantum level in those same neurons; those same neurons that are active. What does it mean to be active? Firing I think is overrated as I think consciousness is in the dendritic local fuel potentials. But also I think it goes down the level of the microtubules which are responsible for synaptic plasticity, memory and probably consciousness. So I think the state equals content maps from the neuro level down a lower level, into the microtubules.

MODERATOR: But you also talked about states as in the state of attentiveness versus the state of daydreaming or mind wandering that we flick between as well.

STUART HAMEROFF: Yes, that's default mode network and I think that's an important point, because most of neuroscience and Giorgio will correct me if I'm wrong, up until a few years ago, was based on looking at how the brain responds to sensory inputs. Show you show somebody a picture and you record what happens and their response. So it's bottom-up and top-down, based on sensory processing and arousal. And this came up in the anaesthesia world because people were saying anaesthetics work by blocking the thalamus. So if you block the thalamus you have no inputs. And I said, what about day dreaming and mind wandering? And they didn't have an answer for that. But Rakel and others have found these default mode networks where we switch back and forward roughly every ten seconds between, A, being in the present here and now and, B, kind of wandering off thinking about what time my plane is tomorrow or whatever, and back and forth.

So part of it is attention, but attention and consciousness are not the same thing. You can have conscious attention or unconscious attention and you can have consciousness with attention or without attention. So those things, although related are, as Christof Koch, doubly dissociable. So in animal studies you can separate them out. So I think it's fair to say that consciousness shifts back and forth between those two different types of modes and we can include altered states and meditation in the default modes, which makes me think it's a self organising process moving around. It's not all directed bottom-up. It's not something, some sensory input driving what you're going to think about, because sometimes we shut off the outside world. We just let our mind wander. So it's more like a celadon or a self organising system which I think is defined by the gap junction envelope moving around.

JAVIER MONSERRAT: In my interaction to the final reflection it was not my intention to give the impression that I was speaking about two different ways to explain the cyclical world and also the brain functions. On one hand we could have the mechano-classical explanation and on the other hand, completely separate, a mechano-quantum addition of brain and of the cyclical processes. I think the real fact in science is what we know in the classical neurology and the classical neurology is what has been described by Giorgio

Innocenti in his presentation now again, a few minutes ago. That is that it is a fact that we have in the brain, patterns, neuro patterns, ingrams, modules and all this fire of structures of networks, of neurons, are producing our psychological experience. This is a fact. We have no doubt about this today, about the brain. The real science is the classical neurology. But there is also another very important fact and we have no fundament to doubt about this. This is also very important for us. This is our phenomenological experience. We are living our lives. We are in society. Society is functioning according to some rules and some ways to understand what we are. And we have a psychological phenomenological experience. We have the experience that we are in field of sensation, in fields of reality. I am feeling my body, I am feeling you now in this pattern of light and this is a fact. And also, it's a fact that unity of consciousness. It is a fact that animals behave with certain indetermination. And also we human beings in society, we have built this society according to the principles of freedom and responsibility.

And it is also a fact and a need for science and for neurology to explain the causes of this fact. Because it would be a science, I think, without connection or reality. A science that would give a completely unreal edition of our experience, for example, I think. We are not robots. That is that the classical neurology has to explain this and normally the neurologist I know man in Spain, for example, the professors of neurology and the medicine faculty here in Madrid, they are not reductionists, because they say, we admit all this cyclical activity, the functions, the normal functions of the human mind; we have the experience. But the question is: how can we explain this? And normally all these neurologists say, we don't know exactly how we can explain, for example, the experience, the field experience and other many things.

I think that for example, to explain freedom, to explain indetermination according to the principles of this classical neurology, the best project or the best ideas to explain this is the explanation of Gerald Edelman, according to the principles of neural Darwinism. It would be a classical description of functioning of the brain functioning and we could somewhere, some way, find a certain explanation of how freedom is possible in determination. But I think that it's very difficult for classical neurology to explain, for example, the field experience. And in this framework, I would say, today there is a moving toward, in science and in neurology, which is looking for a new way to explain things. And this new way is now a strange way, because we know that all matter is quantum matter. And the classical mechanics is founded in quantum science, in quantum physics.

LLUIS OVIEDO: I think that we should bear in mind that the quantum reality we know is a very small part of reality. Because most of reality is composed by dark matter and dark energy so that the reality we know is about 1% or 2% of all the reality. And in this sense, you know it is like a story I was told long ago. There is a beach and the inhabitants of one grain of sand built a spacecraft to go to another grain. And they say the conquest of the universe has started. This is the clarification.

MODERATOR: Thank you for the clarification. The point I was going to throw into the mix, see if anyone wants to pick it up, is, as Javier Monserrat was saying there, he was making it very clear that we can't.. he's not saying it's classical or quantum. They're both in play and we do not have a full understanding yet. But given all the models we've discussed and all the ways we've divided this topic into the physical mind, the neural mind, the quantum mind, the evolutive mind, is there anything that anybody thinks we can take off the table or rub off the blackboard? Is there anything that is now... we can say, we don't need to include that in our enquiries, like, say, the classical computing model. Can we now go, that didn't really work out?

LLUIS OVIEDO: I would clarify, too, to Javier that reality is composed on quantum, but at the quantum level not at the mesa and macro level. That's quite clear that if we study things at the quantum level then quantum phenomena are relevant, but not at other levels of reality, I think. Anyway, I think that it's useful to keep in mind that the problem of consciousness, there are, at least as far as I know, four main answers, solutions, research programmes, paradigms, I am not sure; models perhaps. One is the eliminationist which is the logical result from the physicalist programme. And that's kind of logical suicide. So they decree that the consciousness which is the instance which could say that consciousness is death, that this is the reality or the instance which is declaring this.

The second one is pan-psychism, which sometimes has been proposed by Chalmers and by others. So this is the idea that everything has consciousness, every aspect of reality. Third is the quantum model and paradigm and fourth is the traditional dualism. So my point is, contrary to the idea of Javier in his presentation, that is anachronistic, outdated, is that perhaps it's the less fashionable of these four models. But I'm not convinced by any other models. I don't find convincing arguments by the alternative probe results in order to give a better answer, a better explanation of the phenomenological mind; the feeling, the experience of thinking, of following moral rules, of feeling aesthetic feelings, and so on. But it's a question of which of these four models has more explanatory power and my impression is that each model is able to explain one side of the phenomena, but no model can explain all the sides or better all the sides.

RASMUS WINTHER: Two things; one is the title of the conference is Life, evolution and complexity. It seems like evolution was replaced by consciousness in the title, at least the way that the discussion has been going. So I'd just like to generalise and then make a point, as we all seem to be doing, about Stuart's model. The first points I'd like to just remind, that Stephen J Gould in a paper in 79, and it was then. He develops this later, draws a very nice triangle of what he calls different types of biological explanations and the three are function, structure, history. And so for him, biological explanations can be divided into these three types. They don't have to be mutually exclusive again. They can work together. But roughly, that's for him, what he saw as a palaeontologist, that he saw that there were people focussing more on Darwin and functional explanations. There were people focussing more on inner mechanisms. And so I think a lot of the discussion today Teilhard de Chardin would be more like an... and yesterday, would be more like an internalist structuralist thinker. Edelman with consciousness would have been more like a functional thinker and I'm not sure where to put Stuart, but we can get to that in a second.

I just think it's a very useful triangle and it's a very useful conceptual crutch to use. What I wonder is whether we need to include a fourth type of explanation; call it informational. Because information is another category that seems to have been coming up a lot; so sort of a different sort of explanation. That's just what I wanted to say by way of reintroducing evolution into the title, but using it to help maybe understand what is also at stake in the consciousness debates. The second point I want to make, this is a separate point about Stuart's model, when he was if you remember from his slides yesterday, one of the slides had fundamental reality or something and then there was a dual fork. It's not a fork. There was a branching.

RASMUS WINTHER: Mind and matter and I want to... and I talked a little bit with Stuart about this yesterday. I want to suggest that Stuart's model is an extremely radically... it's a... there's a radical ontology in his model and it's more radical that I think he's even thought of it before. Because it's pre-monist dualist. It's a proto monism/dualism, because

in his model that ontological level is neither monist nor dualist. It's too earlier. There's a quantum indeterminacy about whether it's even monist or dualist. I mean that comes after. That comes once the universe has evolved and then once even the brain has evolved. Maybe before the brain we couldn't even have said whether there was consciousness or not, as a part of the universe.

I want to contrast it with, say, Chalmers's very clear picture in that, in his famous article, *The Hard Problem of Consciousness*, and then developed in his book, *The Conscious Mind*. That picture is essentially just matter, arrow, mind. And then the question is, can you eliminate the top? Or is the top great or it's greater than the sum of the bottom, etc. But I hope it makes some sense. Stuart's picture is so radical. It's a radically new suggestion and that's part of the reason I think it's so interesting. Because it totally revamps most other discussions of consciousness have centred around matter, up, mind, question. Stuart says, no, there's all this stuff under it and he's trying with Penrose and Baum perhaps, not directly, but indirectly trying to develop that picture. Those are the two things I wanted to say.

STUART HAMEROFF: I was a radical back in the 60s; I guess I still am. I want to address what Doctor Louis Oviedo said about a couple of things. First of all quantum isn't necessarily only microscopic. It can be macroscopic. We have entanglement between mountain tops, between satellites researchers have done studies showing quantum entanglement over thousands of miles.

STUART HAMEROFF: We have clear mesoscopic quantum coherence, for example, in the photosynthesis apparatus. So all plants collect photons and then use quantum coherence to get the energy across to the other side of the complex, a micron? I can't remember exactly how long. But as big as the complex is, and that's mesoscopic, which is beyond microscopic, which is what it's usually attributed to; which was what quantum is attributed to. And that's just the beginning. And now Anderbon in Japan has found it along the microtubules with... along the length of an entire microtubule, which is several microns I think. So we're getting into the mesoscopic and people are only beginning now to just look for it. So I suspect it will be in a lot of places that it wasn't before.

The final point I want to make is that, the quantum versus classical. Our model is that consciousness is literally on the edge between quantum and classical. It's not in quantum, it's not in classical. It's literally on this. I think of it as a surface; a self-collapse model. Because the boundary between the quantum and classical is where the mystery is; the collapse of the wave function, de-coherence, measurement, Orch-OR, objective reduction. All that stuff tells us, suggests possibilities of how the quantum manifests the classical and I think consciousness literally is a self-organising process on this edge or surface between these two worlds.

CARLOS JOSÉ CASTRODEZA: I think I would like to because we are diving in very deep waters and I would like to go a bit to the surface and ask this Darwinian question. When is consciousness adaptive and when is consciousness non-adaptive? The pioneer in the philosophy of biology, Mike Rose, has a very interesting book. All his books are very interesting, but there is one in 1986, the title is *Let's Take Darwin Seriously* and there he has a very nice story. He says, let's guess in the forest there are two zebras. One zebra is self-conscious and another zebra is a normal zebra. And so they go to drink at the river and there is a horrible lion smell. So the non-conscious zebra escapes immediately. But the conscious zebra start thinking is there really a lion or is it another sort of smell. And Michael Rose asks which Zebra survives. And this is really the story.

You mentioned yesterday something very interesting, which is the autopilot. If I live in an environment which is totally predictable I don't need freedom, I don't need consciousness; I only need instinct. But if I live in an environment which is unpredictable then I need a manual. The autopilot is not going to help me. And in this sense consciousness becomes adaptive. As we all know, in the origin of man, man emerged in an environment which was totally alien. He went from the forest to the savannas because the forest was disappearing very quickly. Then consciousness became adapted in the sense that natural selection had to do something with it. In this sense I would like to mention a book which for me was very interesting. I don't know if the expert Doctor Innocenti and Professor Hameroff, you are both professors; I don't want to diminish.

It's the book by Lady Susan Greenfield, *The Private Life of the Brain*. In there Susan Greenfield says, associates consciousness to synaptic connections. She says, if there is an excess of synaptic connections then we enter into depression. We get depressed, because we need just that bit of self-consciousness. If we get a bit too much, we get depressed. This is why when we have coffee or we drink wine, Susan Greenfield says, we have the sense of elation. We lose consciousness. And to lose consciousness gives you this kind of cosmic feeling and it's a very pleasant feeling. And, in this sense, I think I have the feeling that the question of consciousness is very good to dive into and to explore the depths. But it is also useful not to leave the surface and see exactly what we are dealing with.

MODERATOR: Thank you, that's also worth pointing out, since I mentioned that people were doing all these analogies about pilots, that you did one about the beach and one about diving, so we know where your mind is going at the moment.

STUART HAMEROFF: Just to say that feelings of elation are not necessary due to dis-inhibition. I think that's the point that Susan was making and you're describing that. If you inhibit functions you let your dis-inhibition come out. This is a story from the ether frolics and laughing gas, when people started messing around with the anaesthetics, that if you inhibit the outer lay you get ebullient and happy and so forth. I think that's very simplistic and I think altered states of elation, for example, are not just because you're less conscious, I think it's you're more conscious. And we could argue about that forever, but I think the monks who meditate and are in a higher state of consciousness have more consciousness at higher frequency gamma and so forth. So I disagree with Susan's... and it's true that a small amount of anaesthetics dis-inhibit you and she's projecting that onto wine and altered states, but I don't think that's right.

MODERATOR: But is consciousness always fit for purpose? Are there situations in fact for humans where it would be good to be less conscious?

STUART HAMEROFF: Sure that is the case for a lot of mental diseases, obsessive compulsive disorder, some forms of schizophrenia or mania for example. You're too conscious and you need to tone it down. And people resort to alcohol and drugs to do that because it's a pretty uncomfortable consciousness. But on the other hand there are other people who fortunately are able to expand their consciousness in a very positive and beneficial way.

MODERATOR: I was also talking about jobs as well. I remember somebody saying, the NASA programme. When you go to interview astronauts, they're usually a bit disappointing, because they're not real livewires, and they say, you don't want somebody who's really that alert sitting on top of several thousand tons of explosives because they would never go to the job. So it helps that they're not thinking that way.

JAVIER MONSERRAT: First of all, I would like to make a very brief remark about the content of the so-called quantum theory of mind. I think that this theory is complementary to all the theories. This theory does not deny the mechano-classical explanation of the world. This is no doubt, in this space, for example, I am here and you, Quentin, are there and you are an object in this mechano-classical world and I am here. And between you and I there is no quantum interaction, can we say. Then these properties, quantum coherence, super position, in the mechano-classical world, the interactions between objects in the mechano-classical world, these interactions do not have the quantum properties. This is a fact and we, in the quantum theory, acknowledge all these facts. The theory is not intending to explain all that we think and along with the complementation, with other theories.

Another thing, I think that to explain consciousness it is very important, at least for me, to take into account a very important concept: it's the content of the psychological subject, the psychic subject. For example, let us imagine a paramecium. We can perhaps admit that this living being, this cell, has already sensation, but there is no subject. Let us suppose a little more ahead in the evolutionary process. Let us suppose, for example, an amphibian, a chameleon. Perhaps this animal, this organism, has in the beginning a certain psychic subject. He's feeling. He's having vision, but his psychological subject has, in this stage of evolution, probably only an epiphenomenal function, because he is like a living automata. He has sensation, but he's an automata.

And after that, for example, if you are speaking about superior animals and about men, we have to acknowledge that we have a psychological subject and if we are speaking about visual consciousness, for example, as Francis Crick says, visual consciousness, in my opinion it is not possible to speak about visual consciousness without a connection with the psychological subject. Is the subject... and the subject probably is also a neuronal state in the brain. But the sensations and consciousness has a relationship with this subject. Without subject there is no possible consciousness.

For example, applying this to the idea of a cosmic consciousness, I would say maybe in the universe there is a quantum state of coherence, for example in light, but if there is no subject to fill this field of coherence, there is no consciousness. Perhaps in the universe we could speak about the final consciousness of God. But this is only in theology. If you are speaking only scientifically, we can't speak about God in this sense. For example, there could be a quantum state in the universe, but this wouldn't be consciousness in my opinion.

SARA LUMBRERAS: I'd like to make a comment. On what Javier was saying about coherence not being as efficient an element for consciousness, because we need to have a subject, what about if it worked both ways? Let me explain better. If we have the Orch-OR model and we say that that consciousness arises from the moment of coherence and we also have, from the point of view of quantum mechanics, that we will have a collapse of the wave function when there is an observer, that is a subjectivity, that is making a measurement, what about having a two-way relationship so that coherence is equivalent to consciousness and subjectivity and the subjectivity is the one bringing the coherence?

JAVIER MONSERRAT: A moment; in connection with this proposal of Sarah, are you saying we know, for example, as I have explained, that we have in this quantum explanation, you have to acknowledge that, for example, the subject is inducing, is producing the quantum collapse and the super position of the brain is taking this collapse or this other collapse and so we can control the brain and, in a certain sense, we can control our actions? This is that we could say in this sense that this coherence and this collapse of

the wave function is induced by the subject. There is a connection between subject and the quantum functioning of the brain.

IGNACIO SILVA: This question I think goes into this psychic subject and it's precisely a question to Lluís and a question to Stuart. Lluís says that he prefers a dualist position because none of the others can give a full account of the phenomenological self. But he doesn't give a positive account of why a dualist position is better. And he doesn't explain how the mind and matter relate and I'd like to know whether the recent explanation, whether there are positive arguments for it in his perspective. And then I was very intrigued by a word Stuart used. He said soul and Rasmus said something about his ontology, so I'd like it if he can expand on the relationship between the soul and your model of consciousness.

LLUIS OVIEDO: Yes, I don't have positive reasons, like in most choices amongst scientific paradigms or research programmes; I just state that the other are less convincing for me. But of course the deep question of how matter and mental states or spirit or soul relate is a perfect mystery for me and, I think, for everybody. But it's a mystery for me this like it's a mystery for me the other problems which arise by the other alternative solutions. But I confess that I have no powerful answer or convincing.

STUART HAMEROFF: You want to know what do I mean by the soul? I think consciousness. First of all, let me go back to Javier's point or, actually, it was your point. Consciousness is not the quantum coherence. Consciousness is the self-collapse and it's not because an observer from outside makes a measurement. That would be the Copenhagen interpretation; the Penrose mechanism is different. You have a quantum coherent super position which avoids measurement, avoids de-coherence and reaches a threshold which is given by a simple equation and has a self-collapse. And that self-collapse is a moment of consciousness. The self-collapse generates the subject.

It's not the subject causes that, because there is no subject. The self-collapse, itself, in the context of the information in the brain is the subject, is consciousness. So it's a series of these self-collapses that give consciousness. So you don't need an outside observer and you don't need a subject. The self-collapse itself is a moment of consciousness which provides the observer, provides a sense of being, of self. And I was talking to Jay at the break, was arguing, discussing about whether you need self-consciousness to be conscious. And I don't think you do. I think that's a higher order thing; that simple organisms can have consciousness without having a sense of self. And I think at times we can also have consciousness without being a sense of self.

I gave the toothache analogy. People take objection to it but I think you can have conscious sensations without recognising, without your pre-frontal cortex, without having self-consciousness involved. The other point about the soul, to me consciousness is a process occurring, as I said, on the edge between quantum and classical worlds and for... so that's consciousness. And because in principle it can exist outside of the body, in space-time geometry, in the near death experience or if the patient dies, the subject dies, indefinitely and perhaps going into another body or perhaps just indefinitely, that it's a reasonable, reasonably plausible argument for the soul in the spiritual sense. And I was surprised when Lluís, Javier and others have said that the church is backing off on the idea of a conscious or a soul outside of the body. And with all love and due respect I say, oh ye of little faith. Because I think it's possible scientifically to have such an entity. Thank you.

KHALIL CHAMCHAM: There was some metaphoric language about surface bottom. There was a mention of reality and the relation of consciousness to reality. So if you are talking

about quantum something which has been mentioned is that what we see in the world is immersion properties of quantum fluctuation of vacuum state. We don't know what is this vacuum state, but we know it's there and it's a reality by itself and from which the reality that we think we understand emergences.

And also from the cosmological point of view, as you mentioned, we know that all that we observe in the universe represents 4% of what exists. 96% is dark matter that we don't know at all what it is. So there is in relation to the reality... what we call reality is just the tip of the iceberg of hidden reality that is there. What does Bernard d'Espagnat? call the hidden reality? He has produced quite a lot about it and it's a discourse that has been with us for many centuries, if you look at the text of Sophie, like in Sophie [unclear] button; the apparent and the hidden. And the hidden reality is much bigger than the apparent reality. And in order to access this hidden reality you have to reach very high levels of a state of consciousness and what Stuart described [unclear] that high level of vibrations or level of frequencies.

So there is some kind of... what I want to say here is that there are lots of parallels between the fluctuation of vacuum state from which the material would emerge. There is this sense of there is a hidden reality that is bigger than our reality, but that we can access in certain mental states, spiritual states, which you could call conscious states. And it appears that the state of consciousness in which we are is just floating on something much bigger than what would be consciousness, to which we can access. So what I want to say is that there is some kind of complement between several fields that should come together in order to provide some interpretation or some explanation of what we think is reality and what we perceive as much bigger reality that we sense is there and we don't know what it is.

MODERATOR: Yes, we've had a reality check. I've got astrophysics textbooks on my shelf that are only ten, 11 years old that don't even mention dark matter and dark energy, because you could actually be a leader in the field and it was not necessarily you had to address. Now we suddenly, probably for the first time in human history, are more aware of our own potential insignificance in the universe than ever before. So that must change the nature of our consciousness, because we're conscious of where we are in the cosmos.

KHALIL CHAMCHAM: Mystics from all religious traditions have been talking about this and this is discord that we should bring in.

JUANI GUERRA: I was just trying to understand something or to overstand something. I was thinking about the difference between hermeneutics and my field, which is poetics. And, as I understand most of what you say, the question that hermeneutics asks is, what does this discourse mean or this text mean or whatever. And the question that poetics asks is what are the mechanisms that make it possible that this discourse may mean something at all. Then, at that point, I start in the most radical or humorous image of all these processes and then I see it as a construction. But my point is, where do these two lines of study of a reality which is a reality as human construction, merge? So we are talking about the way we think about reality or we are talking about what is reality? And that's my question.

JUANI GUERRA: An example is that in Spanish you don't have the word awareness, you only have consciousness. So we don't have problems about distinguishing between awareness and problems, and consciousness. But if you go to Lapponia you have 20 words for it; one of them is whale, and so forth. So apart from the materialising of all these thoughts about the way we think about reality and the most important one is language

itself, language, not the languages in general, I would like to find, or that you can tell me about, a way for the humanities to be materialistic in a sense, so scientific from the human but a very easy one, a simple one: how is it and where is it materialised? I don't mind if it's brain, if it is linguistic structure, as a representation, even, or an object of thought, but I need that.

RASMUS WINTHER: I'm a philosopher by dis-formation. In Spanish you can say the *formación*, right? So I immediately think of Kant when you asked that question about... but I don't want to go into Kant. But Kant is the person you immediately think about. And that's a funny sort... and the, and Kant was the needle eye through which all of philosophy from the Greeks onwards to modern-day, passed through. And I think Kant is incredibly important. Because he provided a way where the question you posed, you can't answer it purely materialistically or purely idealistically. I mean he's famous for that, right? It's Hume plus Leibniz, etc. So the question might be a false one. I guess it's the way you pose that question might be false. Is it how we think about consciousness or what is consciousness? Again maybe it's a quantum indeterminacy, and so forth, there.

But you wanted to ask a question about poetics and you said that there was... you put me on the spot so I'm not being perfectly coherent. But you said you didn't care about whether consciousness resided in the brain and I believe you said linguistic structure and maybe there's body and maybe there's cultural norms. But I think most people in this room would think that it really could only reside in the brain or... the other things are just not that interesting. But I could be wrong. But that might be an interesting point of debate. But what is it that you need? That's what... I didn't quite get the last part of what you said. What is it? You said you needed something. Can you just say again what that is?

JENS DEGETT: I just want to come back to evolution as an extremely important principle also when we talk about consciousness. And I'll give a primitive example of why evolution is so important when we think, when we talk about our understanding on what we are. For example, the immune system, we have some of the components of the immune system is B and T cells and T cells are called T cells because they are developed in the thymus. B cells are called B cells because they are developed in an organ called the bursa of Fabricius, which we don't have because that organ exists in birds but not in mammals. So evolutionary, this organ doesn't exist in our body and our B cells develop directly from stem cells. But we talk about something which has an origin in an organ and you cannot understand the function of this cell if you don't understand the evolution on how these types of cells have evolved and their function involved and why they have been supported by an organ and they are not any longer. Because they need some kind of support and presentation still, even if they don't have their organ any longer.

So with consciousness I believe also that we can talk about an evolution of consciousness, not only from single cell organisms, but also when we go from single cells to multiple cells organisms or when single cell organisms, they work together, they can almost form an organism. A good example, which is always mentioned here is the slime moulds. They are individual cells and they look like small bacteria on a plate. If you starve them they will send out a signal, out. But with this signal they will come together and form a little animal-like, worm-like thing which can move. And this worm will move over the substrate until there is something to eat. And if it continues not to find anything, it will begin to form a body and form a kind of spore house. So it will completely change character and it reacts on the environment. Interesting things for example also, many bacteria, they can sense their environment and react on it in a way which is very surprising. I saw some years ago a project about why fish rot so fast.

JENS DEGETT: Fish get rotten and it is really interesting that one hour it is fresh and edible and the next hour it's completely dangerous to eat. And, the funny thing is, this happens extremely fast, as a very fast switch, and it cannot be explained by the number of bacteria in the fish. It can only be explained because when the bacteria in the fish becomes plenty enough, they send signals to each other which make them switch metabolism. So they take over the fish. They can sense each other's existence and they can change their metabolism accordingly and begin to produce more toxic substances. So there is a consciousness which is, you can say, shared or common even in very primitive organisms like bacteria, which I think is very interesting. And we should think about this in evolutionary terms, because all living organisms, as we know them, have only one origin. If life has started many times, it must have disappeared again in the other forms because we only know the current form of life which is so coherent in so many ways that it's, I would say, unthinkable that it has occurred in several places or times. I hope you understand what I mean.

JAVIER MONSERRAT: An important one, an investigation with bacteria, continuing with your thought the bacteria are social organisms. This is the new paradigm in microbiology. This is the sociomicrobiology. I have a video here which demonstrates that bacteria can communicate.

There are two strings of bacteria, *e. coli*. The string one type is able to colonise the super phase rapidly. Here there are mutant, not able to colonise this super phase. They are 12 cm. Here I put about 1 million bacteria; here another 1 million bacteria. The bacteria change its behaviour to carry out swarming behaviour, and swarming similar to bees. The swarming in this case is completely normal, but when the bacteria finds the other bacteria not able to carry out swarming.

Bacteria send the other bacteria and carry out behaviour to avoid this mutant bacteria. This behaviour of avoiding is a behaviour only apparently intelligence. The new framework to work in the bacteria is the bacteria are intelligent organisms, social intelligent organisms. These are new paradigms which are still controversial.

This behaviour is, for me, very, very strong in the community this behaviour when you and I speak about intelligence in bacteria, or the bacterial community, it's not possible that bacteria have been intelligent. But this movie demonstrates that bacteria have a nanobrain. The nanobrain is composed of a cascade that can control the social behaviour of these bacteria. Bacteria always had communication within them. This is a new paradigm. The bacteria are not stupid organisms.

JAVIER LEACH: I want only to say a word about intentionality. I think we are speaking here about causes. I think there are different kinds of causes and a very important but it is not. It's the intentionality what we are searching for. It means we can be purely analytic, but pure analogies and pure mathematical analogies of reality is not enough. You can prove that purely analytically; you cannot have a theory. You need an intention. You need to affirm a hypotheses, like the dualist hypothesis of Oviedo. Oviedo affirms this hypothesis because he has intentionality. And we all have intentionality. We cannot renounce this. It's necessary. And the question is how we organise this intentionality in a rational way. We have to agree or to believe together, Oviedo and me.

RUFINA GUTIÉRREZ: I think the whole literature about belief systems is just about intentionality, hidden intentionality, as most of the time it is intentionality of belief systems but it's a very complex system. Intentionality is more a point, a vector, but a belief system is a very complex system behind all our thinking and it's the first step to

decide something, to start doing something. Because hearing the whole discussion it's amazing how many times this audience have said, I believe, I think, for me it's better. So it is nothing to do with an analytical world. It's just intention. It's just believing, beliefs. And I think it could be interesting to do a meta-analysis of our thinking.

And even at the bottom of this there is such a strong belief system in the unconscious mind. We aren't aware of this very deep thinking in ourselves. But this is acting always. In common sense, thinking is always acting. In scientific, thinking is also always acting, because we decide one way of research or another, according to this belief system; we are not aware of it. But it's good to know that it exists, that it's a field of research and there are ways of getting access to this world. And it's good to know that it exists, that it manages a lot of thinking, a lot of scientific decisions and it is what you call intentionality. But it's the same mood.

RUFINA GUTIÉRREZ: Well maybe it comes back to our conscious and unconscious zebras. In our conscious zebra also has that gut feeling, that belief, it might get out of there before it starts thinking about it. Or maybe things with zebras aren't that black and white. Over there; thank you very much.

LUDOVICO GALLEN: Of course the excerpts of bacteria evolution is very impressive. But, as an evolutionary biologist, of course we think of bacteria as primitive beings. On the contrary, they have a long evolved history. So I am quite, I don't say enthusiastic, but I'm very curious of this. Because, if I can say this, it's the main proof of the moving towards. Because if is a moving towards more complexity. Structure in behaviour also in bacteria it is a demonstration of this idea. So I ask you the bibliography of this. On the other side, I am back to the book of Crusafont, I showed yesterday. In Crusafont there was the idea that evolution, at least in animals, were going not only towards complexity, but also toward freedom which is perhaps intentionality. So, going on in the evolutionary tree, we are finding more free possibility of choices. We have many choices and the possibility of a monkey to make choice is different from an amphibian or a reptile and the best is in man. This is another aspect of behavioural evolution: moving to [unclear]. I don't know if this aspect could be also applied to bacteria, but this idea of going toward a more complex behaviour also in bacteria is very impressive.

MODERATOR: We're officially into overtime now, so this is your last chance to get something said that hasn't been said, to make a point that hasn't been made and maybe even to get an answer to my question about if there are any of these theories and models that we can remove from the field of play, which nobody's actually yet answered.

GIORGIO INNOCENTI: I don't know. This may be coming a little bit out of time now, but very soon after I've met Lluís Oviedo, I've tried to convince him: Lluís, you have to be ready for the time when all the mind states will be mapped on brain states and then you have to think which kind of position you're going to take then. And we were in an elevator and so then Lluís said something like, hm, hm. And then we got to the floor and we left the discussion there. And then I was reading the sentence that Javier has written for Lluís. It says: the identity theory that is reductionist is not compatible with humanism [human values, freedom, morality, poetry]. Therefore we must accept the dualism, because only dualism is compatible with humanism.

Because I am a disgusting reductionist I'm not really sure what human values are. But let's try, for example. One I'm becoming concerned about is respect for the elderly; that seems to be a human value. But it's disappearing a bit in our society. There is more respect for the young, so this is human values. About aesthetics, look at the kind of women

that Rubens was painting. Look at them from any side and they will be exuberant females. And now look at the aesthetic values today, which have been imposed by all the tailors, and so on. They are completely different. So this is another aspect of evolving and changing human values and I could come with more of these examples. Now I will ask Louis Oviedo is it better to have a fickle soul or a fickle brain?

LLUIS OVIEDO: Yes. The question when you managed to map all the brain and provide a very rational explanation, reductionist successful explanation, is that perhaps I will leave my Franciscan robes and find a more biologically-driven way of life, instead of trying to live a kind of life which is clearly challenging what is dictated by biology or by biological-driven values or by more physically understanding of human beings. So it's the kind of thing that would change completely not only my mind, but my life.

Perhaps the fact that there's people, like me is just to stress that perhaps there is something different. We can rely on different values and different ways to understand human beings and so on. I am not sure about this evolution of many values. There is an evolution indeed. There is an evolution even in our understanding of the face of God.

There was a book published some years ago, *The Many Faces of God*, and the author demonstrates in a very convincing way that even our way to understand God inside this Christian tradition or the Jewish Christian tradition has changed along the centuries and even in short times, depending on context, needs and expectations. But I am convinced that nevertheless it's good that some institution like churches, and so, try to keep an appearance of stability, or limits beyond which it's better not to go. And to keep some points of reference which could be fixed for moral action, for moral values, for the respect, as you said for people who could be deemed from a more rationalistic and pragmatic view of no value, like elderly people, and so on. But it's true that for the case that are very convincing explanation that we could reduce everything to internal physical explanations, it will be a very bad day for me and perhaps I should regret having chosen this kind of life, to be honest.

CHRIS WILTSHER: Just following on from the last two things, a thought that's just drifted across my head. There's a saying, and I can't remember where it comes from: to live is to change. Are we now saying: to live is to evolve? What's the difference between evolution and change?

LUDOVICO GALLEN: In my opinion evolution is also a moving towards. So there is something like moving toward complexity or moving toward better behaviour and so on. Change is only change without any other adaptive meaning. This is my opinion.

CHRIS WILTSHER: On that kind of basis we are making assumptions. As soon as we use the word evolution we're talking about some kind of directionality and so on. My question is, is that correct?

RASMUS WINTHER: I just think that, to be very short, the standard model in evolutionary theory is there is no direction. And the discussion we're having in here is very theologically based. But if you want to know what 90% of evolutionary biologists would say it's no. It's just movement away from, not towards.

CHRIS WILTSHER: But in the way that we talk about it, we always imply that there's a direction. That's part of the contradiction of the way in which we discuss this. It may be that the general idea is that those things which survive, survive; those which don't, don't. But a lot of our discussion here has been entirely about those things which have survived. And we've talked as though it's inevitable that they have survived. My question is: what assumptions underlie that?

MODERATOR: But isn't this analogous to the old thing with the motion picture, when you're watching it on film; it's a series of still images, but we look at it and obviously we put on a layer of movement because it seems to fit. It fits the narrative for us, as well. With evolution there are changes. We see it as being a movement in a direction, because we don't include all the ones that didn't get anywhere.

DENAI GOOSEN: Can there be any state of consciousness without meta language that allows the brain to be consciousness to give meaning of what it is conscious of? Consciousness without language, any consciousness without language; can the brain represent things without language or meta language that tells what, allows it to identify what it is that it is conscious of?

RUFINA GUTIÉRREZ: I would have said yes, but it will also depend on how you define language, I would guess, as well. This is something that Fodor has studied a lot. He speaks about the language of thought. Is it a language before language? So you, and we have psychological experience of this type. We don't know sometimes why we speak about something and it is the inner language. It is not in the conscious, but something is happening, elaborating in your brain, in your mind, or whatever you would like to call it. But at the end you produce something; you don't know from where you have produced it. So Fodor has studied a lot the language of thought. Vygotsky spoke about a nativist language, but nativism is something material but not in the same way of Fodor.

IGNACIO SILVA: On the point of evolution and change and the metaphysical underlying of it, as far as I understand Teilhard and Simon Conway Morris, when they speak of parallel evolution or convergent evolution as having a directionality towards complexity, they are speaking, they are making a pure scientific reflection on their theory. To that we can add the philosophical and the theological reflection that directionality is guided towards something good, towards something not so good, or whatever we want. But as far as I understand both these authors which are well reputed scientists, I might say, the directionality towards, the moving towards, as Ludivico was saying, are on purely scientific grounds. And to that then we add the philosophical and the theological reflection. So I just wanted to say something like that. I'm sure not everybody agrees with that.

CARLOS JOSÉ CASTRODEZA: I think biologically we can't predict the end of consciousness because any adaptation, if it is favoured by natural selection, it's developed and if it is not favoured it disappears. And I think we have a very good metaphorical explanation in the work of Martin Heidegger. Heidegger speaks of the forgetfulness of being. And in 1953 he has a very interesting lecture on the question of technology. The point is as follows. All living beings try to make of their environment an entity as predictable as possible. Because the better we predict it, the better we survive. But the more predictable is the environment, the less we need the manual guide. Heidegger's metaphor with technology is that with technology and science what we are doing is making an environment for ourselves more and more predictable. So a time will come where consciousness will be just a redundant adaptation.

STUART HAMEROFF: I want to come back to the point of aesthetic values that Giorgio raised. I follow Penrose's view that platonic values, including ethical values, aesthetic values, are embedded in the universe in terms of Planck scale geometry. So how would that account for the fact that the aesthetic values of a woman's form or something like even whether cannibalism or slavery is acceptable in culture, and so forth, change over time? And there's a book by Lee Smolin called *The Life of the Cosmos* where he deals with

Planck scale geometry and he claims that it's evolving and changing, it's dynamic. And so platonic values embedded in the universe would also evolve and change over time.

I was in Belgium a few days ago and gave a talk to the philosophy department of Roger Vergauwen. He believes in downward causation. And he was wondering whether platonic values which percolate up and affect our consciousness and whether consciousness can also feed back down and help evolve and change dynamically the platonic values embedded in space time geometry. So, thinking of the big picture, if it's true that Planck scale geometry is equivalent to spirituality or God even, it would suggest that God may be evolving also.

GIORGIO INNOCENTI: I really have difficulties with this because it's pretty obvious that a number of values simply have to do with whether or not a society of humans can survive. If you erase from the values, for example, the don't kill imperative, or you don't steal imperative, and other imperatives of this sort which are obviously based on social conventions. I would add the free will, myth or reality, we don't really know. But essentially now some legal systems in the world are struggling with the idea that maybe somebody made a crime, but it was not really his fault because he could not control; was he really free, etc? And I think that if you go too far with these kind of qualifications you might very well destroy the real basis of human interactions.

And, coming back to what he was saying, that consciousness may be a transient phenomenon in the universe, I totally agree with him. What is going to happen now is one of the by-products of consciousness, is the creation of mass destructive tools and when we will be done with those then the consciousness will probably be gone. And God may still be there, I don't know, laughing or something, but we will be gone as conscious human beings.

