SCIENCE OF THE NOOSPHERE

Eörs Szathmáry and Terrence Deacon

With

David Sloan Wilson

Part Two

David Sloan Wilson: Okay, well, Eörs Szathmary and Terry Deacon to Part Two of the Human Energy's Science of the Noosphere project. And in Part 1, we made a basic connection between the concept of the noosphere developed by Teilhard de Chardin and the concept of major evolutionary transitions, which both of you have pioneered. And then we took that concept from the origin of life, all the way up to higher levels of biological organization during Part One.

And in Part Two, we're going to begin with human evolution, human genetic evolution, and around that all the way up to basically the future of human cooperation in the Internet age. And then come up with some generalities of how all of this can be understood, similarities and differences from this concept of major evolutionary transitions and the concept of the noosphere. So that's an amazing sweep that we've been through together. And so I want to set the stage by just summarizing our current knowledge about human genetic evolution, which is all about cooperation. What we know to the best of our knowledge is that even though we share that fabled 98% of our genes with chimpanzees, there's a night and day difference in the degree of cooperation. Naked aggression is over a hundred times more frequent in a chimpanzee community than in a small scale human society.

And the reason for that is largely a matter of social control. In a chimpanzee society, the biggest strongest individuals get to have their way, basically the bullies win. But in a small scale human society, if you try to bully someone, then you are met with fierce resistance from everyone else. And this becomes what the anthropologist Christopher Boehm called "reverse dominance." It's a kind of egalitarianism, which is vigorously policed. And it's there that we come across the concept of major evolutionary transitions, which is the evolution of mechanisms that suppress disruptive self-serving behaviors within groups, among the lower level units within groups, so that the group itself becomes the primary unit of selection. And I think that should be enough for my introduction. Let me have you dive in as to how you view human evolution, human genetic evolution, originally at the scale of small scale societies, very small groups, and how that led to a capacity for cultural evolution. And that's where Teilhard's concept of the noosphere really kicks in. So Terry, would you like to go first and then Eörs?

Terrence Deacon: All right. So in response to this question, I think it's important to recognize that we depend on each other in a number of ways that are not characteristic, for example, in chimpanzees or in fact, any other species. And it's not only because of our need to forage collectively, in fact, to become foragers using stone tools and carcasses as a source of food in our ancient Australopithecine and homo ancestors. We also need to pass that capacity on, and need to pass on the capacity to coordinate as well as to make these tools, to coordinate our foraging activities together. My own view of this is it requires the beginnings of something that today we would recognize as language, communicating symbolically. The difference, and the critical difference here is that an individual can't do this. This is a collective capacity. We acquire our ability to speak and communicate and understand each other because we're in a social group, but that means we're also for this capacity, dependent on the continuity of that social group.

If that social group falls apart, of course we don't have this capacity anymore and any of the capacities that come with symbolic communication, including our ability to talk about the future, to make plans and agreements, and so on, all of this disappears. In this respect, I like to think of ourselves a little bit like

obligate endosymbionts, we're endosymbionts in a culture, in a society, in which we depend upon this larger host. Without being in that larger host, we don't persist. But that means we also have to find ways to protect the persistence of that larger host, that each individual has a role to play in maintaining the persistence of this larger entity that we call a culture or a social group that shares this communicative capacity. So I actually think that our evolution, that the evolution that drew us so far away from other species in our sociality has to do with also our collective thinking process that symbols provide for us.

That is the thoughts I have are thoughts that I've inherited from each of you to some extent, but also to people as distant as Aristotle and Descartes and Hobbes and so on in our past. These thoughts are my thoughts, and that we are in that respect really integrated with this larger host, a host that is bigger than even the current population that extends in history and space. And so my view is that this is the beginning already of the noosphere. The noosphere is this sort of larger entity. And I think that we've been obligate symbionts in this larger entity, really since the beginning of symbolic communication.

Eörs Szathmáry: Of course, needless to say, I agree with all of that. And what one has to see that it's a recurrent theme for the major transitions, that it was not only the cooperation and formation of the higher level unit, but also the appearance of novel inheritance systems and languages is an inheritance system. This is how you can pass on complicated cultural information. Chimpanzees also have some cultural traits, a few dozen, but with language you can do a lot more, obviously. Imagine such an exchange without language, it would be completely impossible, right? So that shows you the power of this inheritance system. That's one thing. The other thing is when you are pondering about the genetic background of all these changes, then you will realize that there are other very important phenotypic traits that we have. And I used to call them the "human specific adaptive suite," and that has a number of critical components, language is of course an extremely important one, but our ability to cooperate in large numbers, if needed, even if we are not close kin, that's a remarkable thing.

Then we have teaching, very efficient teaching. I mean, chimpanzees have roughly one example of teaching and they learn how to crack a nut with an anvil and a hammer in about two years, that's a little bit of a modest thing. We have this shared intentionality. So that is critical for planning complex cooperation, because I can imagine that you pay attention to the same thing, knowing that I pay attention to the same thing and we can achieve something together. So it's not only shared attention, it's shared intentionality, which is actually more, and then of course the way we are using tools, right? So we are not only making tools in large numbers, there is also the carrying of tools, which is important. I mean, we can stick to them.

And also what is very important and that's a very important cultural thing that we can use tools in order to make other tools. That shows you that there is a network that unfolds in this intellectual domain. And that's a little bit similar to what Terry used to talk about, that it's words and symbolic reference is not only just words individually, but it's a network, the cross-referential network and they get their meaning from each other mutually, right? And our tool use is much more like that rather than just using individual tools. So, obviously these are extremely important. What I want to say is that usually people, people say in evolution that you shouldn't try to select for several different things at once, because that's too complicated, that that becomes difficult squared, difficult raised to the third power, right? It will become very improbable.

I actually think that in the case of the human specific adaptive suite, whenever there was mileage in terms of genetic evolution, for example, in the efficiency of teaching, that of course immediately gave you a mileage in other things as well, right? If you are more efficient in teaching, probably you will be also more efficient in learning your language at whatever stage you are and vice versa. So it's something like a co-evolutionary wheel. That's the other metaphor that I make. There is the center and that are these radius spokes. And they had in a synergistic way, each other's evolution, this is very important. The synergy is very important here. If they are not adding these things, they are synergistic. And if you finally

ask, okay, what might be the genetic background to all these changes, then I would submit that it is some very important procedural capacities, right? It's not any concrete rule of universal grammar, if you believe in it at all. But even if there was something like universal grammar, I think that the genetic evolution was not influencing that directly. What genetic evolution was influencing were some procedural capacities that people were using then in various domains, intentionally, for tool use, for assembling more complex utterances and so on. And this is I think the right level, the most exciting part of the genetic foundations of what has happened to us. And then later, we will come back a little bit to the endosymbiosis, because that is an interesting model. But I shut up for the time being.

DSW: So that's great. So much to summarize here. One is, is that everything we've been talking about is a form of cooperation. And so, the idea that cooperation came first and then all these other things followed from cooperation, I think is a big part of this.

Another point to make is that, a lot of what we've been talking about is cooperation at a larger scale than the small group. When we're talking about language and cultural toolkits that are shared and transmitted across generations, there's what you might call a tribal scale.

Something that has to consist of enough individuals that it's comprising many just foraging groups. And I think there's a a received story that first human society was very small scaled and then it got larger. But that larger scale, I think, is emerging way before agriculture. The book now that's being much discussed is called The Dawn of Everything by David Graeber and David Wengrow.

Which is basically reporting quite recent developments in archaeology and paleo-anthropology, which shows that human society became large scale before agriculture. And that includes monument building, and things that we associate with hierarchical society. And yet, that might be false. It might be that that society could become large and remain egalitarian in the same way that we think about small scale egalitarianism.

I want to cover one thing before we move onward, which is that, one of the most provocative things that Teilhard said was that, because humans represented a new evolutionary process, cultural evolution, then that means the origin of our species was as significant in its own way as the origin of life.

And when we were talking about the origin of life, and often these discussions center on, now it's DNA-based, but was it always, would it have to be DNA based on other planets and the like? It seems to me that we don't have to speculate about the origin of life on our planet or what might take place on other planets. Because if we really think about human cultural evolution as a full blown inheritance system, then its mechanisms are very not at all DNA-based, they're not even materially based in some sense. And so, we can think about an evolutionary process in the ingredients, does there need to be a replicator, for example? Is there anything gene-like in human cultural evolution?

And so, I'm really eager. You're just the right people to be talking to about this. How could we be thinking about human cultural evolution as an inheritance system in which the whole mechanistic basis is obviously evolved by genetic evolution, but now it is not gene based? And so, I'm really eager for your views on this very deep topic.

TD: It's interesting that probably all three of us have slightly different views of this. And I think, comparing these views will be very interesting.

My own view of, there's this idea that Richard Dawkins came up with in the mid 1970s, the concept of a meme. That is a copied unit like a gene that occurs culturally. This has been a topic that's recurred and recurred, and come back in various forms. It was made very popular in the Internet and with computer viruses and things like that, that made it very clear that there is an evolutionary copying process that could occur culturally.

There have been many critics of it. I'm one of the critics, in fact, of the idea for a variety of reasons. And maybe as we move along, maybe we can talk about why I think there's some difficulties with it, what I think is right about it, and what I think is wrong. But from my perspective, the real question is not just saying that we've got this. Or that some event happened and suddenly we became cooperative. Or that some event happened neurologically and language became possible. It's that transition that's so hard. And this is something that Eörs of course in the mid 1990s was struggling with, is, what was the transition? What are the processes that allow us to move from a more or less non-cooperative to much more highly cooperative? And eventually, I would call almost an addictive cooperative relationship where you can't get out of it.

Or you call this, Eörs, I think, contingent irreversibility. You get caught up in something and you can't go backwards. I actually think that, that's a way to think about our own evolution as well. That as we began to forage on a food source that could not have been accomplished by individuals. That is, if you have to forage on the open savannah to basically cut off bits of meat from a carcass that large predators have actually taken down, you have to do two things. Somebody has to be cutting the meat, but somebody has to be defending the cutter, so to speak, so that other animals don't come in to go after it and so on. That requires the kind of cooperation that is exactly contrary to the other kind of competition that typically goes on in a social group, in which males are intensely competing over females and access to dominance in various ways.

So to some extent, there has to be a suppression of that dominance tendency in order, just to get there. I actually think of these processes, the linguistic processes, the cooperative processes, the tool making processes, in the way that that Eörs was saying just a few minutes ago. That is, I think they potentiate each other. You can't move ahead without all of these areas; moving ahead, incrementally.

I suspect it took as much as a couple of million years for us to move in this direction, for each of these to potentiate each other. But in that respect, it does seem to me that the crucial story here has to do with how this transition takes place. I think that that transition and the transition to life have lot in common. Because the transition to life was a transition in which you've got chemical and physical processes that tend to wear themselves out. That's basically the second law of thermodynamics, is what drives it. These are analogous in a very crude sense to competitive processes.

Processes tend to run down spontaneously. Somehow, life figured out how to not have that happen. And once that happened, then you need also a way to remember it and to then reinstate it generation upon generation, material after material. That's the replicator side of things. But I think, initially, it has to start slowly and move in this direction. I happen to tend to think that DNA and RNA are not where it starts. And this makes me a renegade in the current context.

DSW: I wanted to highlight two things before I pass to you, Eörs. One is, I'm glad you pointed it out, Terry, that there's really two factors in the evolution of cooperation of our species. One is social control, which I've already mentioned. But the other is the ecological need to cooperate, especially on the savannah. There were just more things that required cooperation than life in the trees, for example. So thank you for emphasizing both of those. In my conversation with Lesley Newson and Peter Richerson, that was also emphasized.

And the second point I want to bring out is that, even when social life becomes obligate, that does not prevent the cheating problem. After all, in multicellular organisms, we still have the problem of cancer. So no matter how obligatory social life becomes, so that it's basically impossible to live as individuals, you can still live as free riders, or as bullies, or exploiters, or so on, within the cooperative group.

And so, that means that there has to be something in human cultural evolution, like the immune system. There has to be some sense in which human societies are well protected against disruptive behaviors always, all the time, never an exception. No matter how obligate social life becomes, they're still

vulnerable, basically, to the social equivalent of cancers. And so, maybe you can just comment on that and we'll pass that to Eörs.

TD: All right. A very simple answer is that, of course, this is the basis of all of our great literature. The fact that it's always with us. That the competition among brothers and relatives, even close relatives, this is the basis for a lot of Shakespeare's great works. And of course, there's always the criminal, the enemy. This is a characteristic of all of human existence. Cooperation always comes with this risk. So, yes, absolutely.

The real challenge is that, it's always in balance. And that balance can shift and go up and down in various ways. And the key is that, as we get larger and more interdependent, more codependent, I would actually say, that you can't live without each other, in some sense, the risks become higher as the system breaks down. That means the defenses have to become more intense. And as we have grown our societies now to global scale, the risks are incredible because the codependence is so intense as well. And I think that's one of the challenges that we're facing.

ES: Let me come back to a few items, because I think that they are fascinating. So let me comment a little bit about the origin of life, and the origin of our species, and language, and so on.

First of all, I have good news for you, Terry. That, actually, an increasing number of people don't think that RNA came first. Moreover, there is an emerging field, what is called systems chemistry. And systems chemistry owes its origin to a number of people like Tibor Ganti, who was actually one of my mentors. And those are self-maintaining organizations in organizations in which a template replication element is just one element, and you can actually start smaller.

So right now I am reporting that we have a manuscript under consideration, where we realized together with Andrew Griffiths in Paris, a self reproducing vesicle that has metabolism in it, is the foremost reaction. So it's incorporating formaldehyde and it grows because it is an autocatalytic growth. So more of the internal material makes more of it, but there are no genes here. But because of that, the compartments grow. And then if you shake them, I'm simplifying, then they actually will fall apart into two, and then there is a next generation. So more and more people think that systems like this precede template based digital type of information. There's a latecomer in the origin of life. That this is what more and more people think.

TD: I was just going to comment that, of course, as David knows, I've also just recently published a piece that not only lays out an argument, like what you just described, maybe you've seen it. It came out in the journal, Biosemiotics, just this winter. That actually walks from that kind of a system to a system with the first template, and shows how the template can about—that is, can carry information about the other processes. If you haven't seen it, I'd be very interested in your comments.

ES: I would love to see that. There is another thing that I want to highlight here as a way of analogy, and that is at a later stage, when you go to something which is the genetic code, which means that you have two families of macro molecules, and there is a translation table from nucleic acids to proteins. And there is a division of labor, these are all recurrent themes, as you know. And then, for the most part, the nucleic acids are storing information, the proteins are doing the work, which means, catalyzing the chemical reactions. But you have to translate one family into another. That's the lookup table, is the genetic code. Now, if you consider the origin of that you will see that the origin most certainly, was something that you would call iconic, right?Which means that, there was a physical interaction between certain nucleic acids sequences and certain amino acid sequences.

However, today, the situation is something that you would call symbolic. Because of evolution, the system now looks like you can actually reconfigure it. So there is now not anymore an iconic necessity between a triplet of nucleotides and the amino acid that is encoded. You can actually rewire it and you can modify it. You can introduce new amino acids. Which is again, coming dangerously close to the origin

of language, where I think that gesturing, which has a strong iconic part in it, was actually one of the stepping stones whereby you could go to the symbolic reference.

DSW: So the genetic system is itself a symbolic system.

TD: I agree entirely.

ES: That is what I wanted to say about this analogy. And you kindly refer to what I call the confrontational scavenging scenario for the origin of human corporation and language. I think it's a valid one. But I have to emphasize that, this situation, the confrontational scavenging, as you describe it, it requires such tight cooperation. That the usual problems of punishing, and gossiping ever. No, if everything happens in front of your eyes and if somebody doesn't cooperate, then there is a very severe problem. Because everybody immediately sees the problem.

So either if the guy stays at home—somebody has to stay at home, so to speak. If there is no work performed there, everybody will see it. If there is no share of the defense and the butchering, again, everybody will see it. So it's a situation where it is almost impossible to cheat. I think when society becomes more complex, there is actually more room for cheating.

DSW: So let me move our conversation along, I've so much to say about that, including Elinor Ostrom's core design principles. Basically the period of time in human history, in which society increased in scale, that was also a multilevel process. In this series of conversations, that's covered by my conversation with Peter Turchin and Daron Acemoglu. And so, what do you have to say about that period of history?

I think what I have to say about it, is that if we actually begin with the work of Daron, which is on current day nations. He makes a distinction between inclusive to extractive. There's a spectrum of current national governance from extractive societies to inclusive societies. And he makes the point that the inclusive societies work better. And so, we have multilevel selection playing itself out at a very large scale. Some large scale societies are captured by elites, for their benefit. So there's all kinds of internal processes that tend in that direction. There's your within-in group selection. But because they don't work very well at societies, they tend to get replaced in competition, either economic or military competition with societies that are more cooperative.

That is evidently what explains the Axial Age with the major religious traditions emerging as a social glue that holds societies together in the tens of millions. But always in competition at a higher scale, cooperation always takes place in the context of competition, military and economic competition, at a larger scale. And so, what do you have to add to that story? And the reason I'm maybe rushing a little bit, is because I'm so eager to get to the present and future. That now, when we think about these ideas in terms of expanding the circle of cooperation to the global scale, what the concept of major evolutionary transitions has to say about that. So with apologies, please speak briefly on the last 10,000 years. And Eörs, why don't you go first?

ES: There are a number of issues here that we have to tackle, really. One of them being what I think is extremely important, is what people call the rule of law.

Now, the rule of law means that you have rules of behavior that are more or less codified. And if you violate them, then you will suffer one way or the other.

Now, this cannot be very complicated and very precise, unless you have a way to actually, express them in such a way that it is easily accessible without personal interpretation, without modifications by gossip, and so on.

So I think that writing, it's again an information carrying system, and it's again an inheritance system. Writing is amazing because it can pass information from one individual to the other, even if they never meet. That's extremely important.

That's a very important innovation. You can have social norms without writing. But I don't think that you could have the rule of law without writing. That's a more complex phenomenon that rests on the possibility of writing. But that's one thing.

The other thing is that, of course, you want to become safe, you want to have something which is predictive for the future, you want to have stability.

And I think the origin of agriculture delivered exactly that. It was the stability of the foundation of the existence of the different groups. That was a very important, positive effect of agriculture.

But as some people pointed out, it has its downside. For example, you have to work a lot. If you calculated, the people who are doing agriculture were working more than people who were in hunter-gatherer societies, that seems to be the case.

What is the measure, what is the utility here, as the economist would say? And that depends on the perspective of the individual and the group, and also it depends—and that's an important thing for the future—it depends on values. So if you have different values, the utilities will also immediately change.

Although they refer to the same mechanism, or the same action, or whatever, the utility, that you want to work with, will actually change. And I think that's a culturally defined thing. It's very important that it is coming from cultural evolution. Although it is true that it does affect your brain.

There is a very nice experiment showing that your cultural environment actually influences how you will become angry, for example, in a social context. There are beautiful experiments to show that.

And that is because the value systems that works inside your brain, a great part of that value system is not innate. Some of it is innate, obviously. You want to breed, you want to reproduce, you want to defend yourself, okay. But for many other things, even the values are learned. So the values become internalized. That depends on the social context. And then it'll affect your existence.

Even your biological reactions, shame, and all these things will be affected by the internalized values. That's a very important element of society. And it's not a miracle that if you look at the history of mankind, you will see an enormous amount of quarreling and antagonism that rests on different approaches to what a value is.

Think of the religious wars, think of liberalism versus illiberalism ideology, this affects values, obviously. Probably our capacity, or our addiction, to actually work according to our value systems, is something that is innate. Not so much values themselves, but the capacity to internalize and to be very sensitive to that, I think that's innate. That's a very important thing. And its evolution might have actually continued for quite a long time. But of course, the most spectacular forms of this evolution came out of cultural evolution later.

All this happened then gave rise to very large scale non-egalitarian societies, and here, I must say a caveat. And that is that, cooperation, whether it's good or bad is again in the eye of the beholder, right? The mafia is an excellent system of cooperation. You could teach cooperation on this example and you could introduce everything, food sharing, punishment, whatever. But for the rest of the society, it's not such a jolly good idea. And that generalizes to something that you are so much interested in, David.

So what are we going to do now and are we going to do in the future? Because all these genetic and cultural mental practices, templates, and whatever we have, can be used for the right or wrong. You can use the Internet for right or wrong, you can use chemistry for right or wrong. So the mechanism is there,

but whether you are actually doing something sensible with it in the long run, that's an open question. That is what I wanted to say.

DSW: Just to nail that down. That's the essential message of multilevel selection, is that cooperation permutes to selfishness. Self-preservation is a good thing, until it leads to self dealing. Friends and family is a good thing, until it leads to cronyism and nepotism. My nation first is a good thing, until it overheats the Earth, and so on and so forth. And so, evolution doesn't make everything nice. And actually, when you take that to its limit, it requires a whole Earth ethic. Anything less than a whole Earth ethic is going to create problems up the scale.

And another point I want to bring out, which is staring us in the face, is that, above a very small scale, the very existence of groups requires symbolism. Groups are so socially constructed, that how are you going to know that someone's a member of your group if you're not wearing the same clothing, or hairdo, or tattoos, or whether you're the same clan-

TD: Or speaking the same language.

DSW: And as Durkheim said, one of my favorite quotes from Emile Durkheim, is, "At all points in history, a social life is only possible thanks to a vast symbolism." And so, symbolism is required from the very beginning, in order just to define groups and what we do within them, in a very contextual fashion.

So Terry, take your turn and then let's fast forward to the present, and then we could see how these ideas which are so amazingly explanatory, can be put to use in the current day.

TD: So I will start with the present and future, and work back. And that has to do with the problem of multilevel selection and what it poses for us now. Multilevel selection is about groups competing with groups, of developing cooperation within groups. Our challenge, of course, today, in the present and the near future, is that there is no other group with respect to which the whole human population will be competing.

Now, the reason I say this, is that although we know as Elinor Ostrom and others have suggested, we know with larger groups, how they get held together. The question is, the process of getting there. The process of getting there in group selection arguments is group competition, which forces cooperation within the subgroups that are in competition. We are no longer there. And that means that the process, at least, is going to be different. And that's one of the things I think we need to talk about.

There are three concepts that I want to suggest that might help us with this problem. I'll cover them each and show their relationship to each other, because I think they're obvious. They're obvious when we look not at multi-level selection in between groups, but when we look inside of organisms. That is, what has driven cooperation inside of organisms so that cells are cooperating with each other, molecules are in a sense doing division of labor, and so on.

The three concepts are, first of all, division of labor, which is crucial in large cooperative complexes, whether it's a body, or an ecosystem, or a society.

The second one, and I think it's a major important feature that was brought out by a series of researchers beginning in the late 1990s, is just surplus. Why surplus might be important to all of this process. Because natural selection works in the context of both some surplus, some possibility of doing things differently because there's enough there. But it also works in the context of, not enough. That is, you overproduce with respect to the resources that are there. This is what drives selection.

But surplus capacity is something that happens, for example, with the ability of cells to multiply. So in a growing body, you're developing surplus.

In a gene evolution; when genes duplicate, they have surplus capacity, in the sense that, now you have two or three or four genes doing essentially the same thing.

That relaxes natural selection. It's just the reverse of the context in an ecosystem in which there is a limit of resources. Now you have a surplus. And what that means is, some of the duplicates can now begin to degrade and you don't lose functionality.

And so, since the 1970s, since Susumu Ohno suggested this idea of gene duplication as being a major driver in evolution, it's now been recognized that what's going on here is sub-functionality and effectively division of labor results under these circumstances. Because it allows the drift of the duplicates without a cost, but that requires surplus.

And then finally what I want to describe, is that this leads to what I would call offloading. Because what division of labor is, is you've offloaded some function that one group produces, that some other group or some other individual produces.

Now, the nice thing about surplus and allowing things to relax, is that it allows variations to show up. Drift, to show up. But this also allows those individuals, or those capacities, or those genes and their products to have a higher probability of drifting into complementary relationships. But once they're in complementary relationships, now, some other functions can be lost. That once you can depend on somebody else to do the work, you don't have to do it. But by simply the second-law-of -thermodynamics-like effects, maybe the capacity to do those things degrades.

One of the things that we know about evolution is that, whenever offloading takes place, whether it's in commensalism, symbiosis, or other forms, or just simply gene duplication, one of the things that happens spontaneously because this is the way nature works, is things degrade. If they're not held in place, things will degrade. Natural selection is a process that under conditions of limited resources, you maintain things in place. But when you've got a surplus of capacity, things can degrade. But when they degrade, they can become codependent. And once they're codependent, they need to stay together. The system can't fall apart.

So, how does this apply to our problem? Our problem, as I see it, is that we've used group selection. Group selection has driven a lot of biological evolution, a lot of cultural evolution, as groups have competed with each other and forced, internally, cooperation.

And one of the things that happens is that you get offloading in cooperation, because you get these systems where they now can in effect each do parts of the job and not the whole job. That's only possible if you've got surplus. You can't have an army if you can't get surplus. If you don't have everybody making goods, you have to either have them available to steal goods, or you have to have somebody that stays home and makes the goods; you store your grain and you send it out with your army.

You need to have surplus, I think, to grow like that. But surplus, I think, makes successful group selection possible. But group selection allows the individuals in the group to become more and more codependent, and lose the capacity to not be codependent; to become, in effect, addicted on being in a larger social group. And in that respect, it’s a ratchet. It's hard to go back. It's hard to let the thing fall apart without it completely falling apart.

So I actually think that what's happening currently is that, we have such surplus and such codependency, that we're at great risk. But now collectively at great risk. So I see it less as a group selection problem now, than as a problem a little bit like, how organisms, individual organisms are forced to become more internally synergistic. How each part becomes more codependent on each other part. The question is, that's a different kind of evolution. Now I think it is not impossible that top down control, governmental control, and wisdom can set this up and say, "Look, this is how it becomes stable."

I have less faith in that, more faith in the spontaneous process that has actually been evolving in the world to produce organisms. So I'll stop at that. But just my idea there is that, in effect, I think we've come to a point in history when the nature of evolution is probably different.

ES: I think that mankind has never had before this opportunity that we are put to a test of global cooperation, which I think literally is a matter of life and death for civilization. I don't think that even if there is civilizational collapse, that the human species as such will die out, unless there is an incredible catastrophe or whatever, but I don't think that. What I think that what is at stake is the continuity of what we call technological civilization. And there I see a serious problem for a number of reasons.

One of them is obviously climate change. Climate change will be a problem which will become worse for more and more people this time, that's a safe forecast that we can make. That's one thing. The other thing is that we are overusing the planet hopelessly. There is this idea of the ecological footprint. The ecological footprint is now over 150%. And if somebody thinks that is sustainable, the person must consult somebody in a psychiatric clinic or whatever, obviously that's a no-go, that has to change radically.

The third problem is that because of all these things, climate change, that I think is now the overwhelming evidence is that it's actually man-made, it's new to us, and also the ecological footprint. So now we actually have since roughly about the beginning of the industrial revolution, an exponential increase in the death rate of biological species, and obviously that's a threat. I used to make this analogy, that actually it's a real story that somebody was sitting on a Russian airplane in the 1980s. And the guy just noticed that screws were popping out of the wing, one after the other, and the guy was scratching his head, okay. So probably, there is a lot of safety in designing that, but surely there will be a point, no? When you take out one more screw and the thing will break, the plane will crash. Although it's very hard to tell when exactly it will and I think that we are facing the same problem with ruining our biosphere. If you are removing species at an exponential pace, you are going to face this problem. It's too complex to predict where it will crash, but one thing is sure, it's more and more likely to crash, if you continue this. Now, in order to change all this, we need an unprecedented amount and quality of cooperation. And this has to be practically universally shared. And the problem is that here there are really no free lunches. It will come at a great price.

You have to exercise an unprecedented quality and quantity of self restraint. Otherwise it's not going to work. And there is one strange remark I wish to make here. I think that one way or the other, the reason why the present situation is not sustainable in the long run has to do something with the very nature of capitalism. Now, I know this is a very strange statement and probably people will not like it, but I have to say, I am coming from a poor former communist country, and we hated communism passionately. But maybe one of the most important and most disturbing consequences of communism is that it has discredited ever thinking about possible alternatives to capitalism, right? You cannot even mention it in polite society. Although, what I think is that its capitalism. Capitalism was a very good idea until the world seemed to be infinite, especially for those who benefited from the system, but that's over.

The earth is finite and we still have this tendency, the exponential nature of capital and everything. So capitalism has done a lot of good for us, but I fear that if the system doesn't change profoundly, it will be also the reason for our collapse, ultimately, because it's not sustainable. And that would be a change of unprecedented magnitude, especially if you think about it, that we don't have much time. That's the problem, right? Economic and social systems have changed in the past. Capitalism wasn't around all the time. And you can argue that it's not going to be with us forever. If you survive, something must replace it. But I fear the problem is we are under an enormous time pressure here, and this time pressure is vexing.

And this is why I fear the technological civilization actually might collapse. And unfortunately, this is consistent with what people call the eerie silence of the universe. People have figured out a long time

ago, that one of the reasons why you don't see, you don't have really hard evidence for civilizations elsewhere in the galaxy, that it might be that because all of them have, in a very broad sense, a biological origin, they are going to face the same problem. And if it is true that the average lifetime of technological civilizations is limited, then of course, there can be several, but they will not last long enough in order to meet by any means. And maybe we are going to be just another example of this fate.

DSW: Right? So it's really important for you to inject this.

ES: This is what I wanted to say, sorry, I'm ruining the party in a way, but I think it's important to ponder this.

DSW: It's very important for this sober assessment to take place, because so often the noosphere is interpreted as some inevitable march towards global cooperation when it is nothing of the sort. And it's a good moment to introduce and to discuss the concept of evolution as a process, which can be consciously directed. The modern synthesis worked very hard to describe evolution as having no purpose and no conscious component. But in retrospect, I think that only makes sense in the narrowest of contexts of Mendelian genetics as imagined back then,. And for example, artificial selection, what farmers do every day, to select domesticated breeds of plants and animals is a process of conscious evolution. They're consciously selecting some trait, and they're using variation and replication in order to do it. And so against that background, I think if you look at just a normal garden variety human decision making process, where people get together and they want to do something, so they have some objective and they make decisions around that objective and they do what works best. I mean, that's basically a process of artificial cultural evolution and it remains evolutionary.

So the point is, is that cultural evolution can be conscious. It often does have a conscious component. I mean, one of my conversations in this series with Josiah Ober on ancient Greece, the emergence of democracy in ancient Greece, amazing conscious intentionality of how do we evolve a democratic city-state? And there's a deliberative process. That's what they set out to do, their institutions, their populations, an incredible intentional component to that. But of course, with cultural evolution, there's also a very large blind component and often intentions turn into random noise with unforeseen consequences and the like. But the point is, to bring it to this conversation and maybe the close of this conversation is that really our only hope for global cooperation is it for it to be more of a conscious process than ever before.

We must have the global welfare as the target of selection. We must orient variation around that target. And we must replicate best practices with that target in mind. And everything that takes place below that level, our nations, our religions, all the way down to our smallest of groups have to be coordinated with the global good in mind.

What that means for me is that it's theoretically possible. That's where my optimism comes from. Is that this is theoretically possible, but whether it can be realized, that's where my pessimism comes from. So I think that leaves us with a stark choice. This is something that can take place, that global cooperation that Teilhard envisioned, it can happen, but only if we steer towards it and it will never self organize. It will never happen by a blind evolutionary process. Only by evolution becoming more conscious and more globally oriented than ever before is my assessment. And so let's have a final round Terry and then Eörs. And what a trip we've been on, from the origin of life to the dubious future of humanity hanging in the balance.

TD: All right, now I'm actually an antagonist to the notion of conscious evolution. And I'll tell you why. It's not that I don't think it's theoretically possible that we could design a future, that worked. I think it's very unlikely and I take many of Eörs's comments to task on this. I think they're correct.

But let me go back to the very beginning of this. And this is one of Darwin's insights. That is the insight that maybe we can use the example of selective breeding, artificial breeding as a model to sort of

extrapolate to natural selection. There's a fundamental difference. And I think about this as a difference between engineering and biology, engineering, causality and biology. In engineering parts are found because you have a future in mind, a model of what should happen in mind. We grab the parts from wherever we find them thinking about, well, we think they'll fit together this way. And we assemble them, it's not functioning yet, this device. And finally, when we get them all together, we add the energy and get the thing running and see if it actually accomplishes what we imagine. That's engineering, it grabs parts, puts them together, assembles them in this assembly process with an end in mind. We may or may not get what we want. Oftentimes of course, there's a lot of trial and error, many failures, many unintended consequences in the way. And I think that's one of the challenges of all engineering. Now, when we think about selective breeding, what's going on, is that the farmer, let's say the breeder is saying, I would like cows to produce more milk or that produce milk irrespective of the fact that they have not given birth. Maybe I can select cows on this one trait, that's engineering.

Although Darwin used this as his model, I think that's an engineering model. And I think it's dangerous to carry them across for the following reason. In the natural world, species are evolving as holistic elements. That is all the parts are already functioning and what's happening is that the balance of those functions is best suited, best fitted to a particular context. That means it's not just milk giving. It's not just long tails. It's not just fighting ability, but it's rather the integration of the organism. When we put all these traits together within a context, that context is in effect selecting the synergy, the best synergy that we see in the collection of variants that are available. That's a very different prospect. It's not going in and manipulating one or 10 even, of these features, it's that the synergy of the organism is being assessed by the context that it's in.

Now, that's a very different story. So now the challenge is that, of course we can get better and better at this. If we really understand the systematic structure of genomes, for example. If we really understand the epigenetics that's involved, the complex epigenetics using our massive computing capacities and lots of experimental data maybe we'll become better at selective breeding at the gene level with CRISPR Cas9, for example, where we can go in and manipulate 5,000 things at once and get it to work out. I think by genetics we've been lucky because organisms like ourselves have evolved in the context in which each generation, 50-50 collections of genes get thrown together at random from two different individuals. And they just happen to work well together. That means that this system is very robust to recombination, which is a remarkable feature of organisms, which means that maybe there's enough robusticity, so that engineering doesn't really ruin things.

My sense is that there's another way to think about conscious evolution. And that is how do we create an environment that selects for the synergy of human interactions. That doesn't legislate them, that doesn't tweak any individuals, but actually creates a global ecosystem that selectively favors this situation. Now, I think we're actually creating a little bit of that by things like global warming. I think it's actually creating a situation where we will all need to work together to resolve it. We won't have a choice. The synergy will be driven. So it's a pessimistic/optimistic perspective I'm taking here. That I think will push things bad enough so that the environment itself will play a selection role and might force us together, might even force us to destroy our nuclear weapons and turn them into a small nuclear plants that we can distribute around the world in order to bring down the carbon in the atmosphere without generating more carbon.

There's all kinds of tricks to this. But again, what I want to say is it is like conscious evolution in the sense that it requires forethought, but it's unlike design. And I think what we need to do is to think beyond both our evolutionary models and our models of engineering in order to make this work, I think that's the only answer.

So what I'm against with the conscious engineering, I should say, I think it's conscious engineering, but against the notion of conscious evolution, I don't think that's evolution. I think that's engineering. And I

think we make the mistake of confusing engineering for evolution in the same sense that Darwin overdrew the analogy between selective breeding and natural selection.

ES: Yeah. I think I will agree with Terry on the idea that what you need is facilitation, partly because what you are looking for is useful novelties that can radically change the state of affairs. And that is exactly what you cannot design, right? I don't think that you can design because this is in the nature of the novelty. What you can facilitate is that actually you have an environment where novelty search is more possible than ever before. Actually, there is an interesting twist here if you think about evolutionary algorithms and these kinds of things. So the plague of evolutionary algorithms was for a long time, you always gave a fitness function, right? And whereas in the real world, the fitness is an emergent phenomenon of the holistic life cycle, as Terry was explaining, right?

But the engineers insisted on a fitness function. And in many cases, they were completely surprised that even if the system solved the problem, the solution was not at all what they wanted because, and that's a real story, once, for example, the system solved the problem by actually noticing that there was a regularity in the room of a certain shadow. This shadow was used as a proxy to fake the solution. The solution was perfect from the point of view of the algorithm, but it was completely useless from the point of view of engineering. And I think that there is a problem. Whereas in the last 10 years, there are much more relaxed, and much more permissive approaches to such algorithms. And one of them is actually called novelty search, and novelty search is, well, I'm simplifying that you have to let the components of the algorithm just play, right?

Don't accredit a fitness function immediately because then you are in such a narrow path that you are unlikely to come up with interesting things. Just allow novelty to appear for a good time. And then you can actually try to see, okay, what kinds of things, and then try to fish. So I think that society should be much more conducive and permissible to novelty search, but now in the cultural domain. And I agree that that would be probably the only hope. And maybe I mentioned previously, I'll mention it again, that I accepted a year ago to be the chairman of the presidential committee for sustainable development of the Hungarian Academy. And people ask me whether I'm optimistic or pessimistic. And I said, well, I'm pessimistic, but I'm acting as if I was an optimist, right? And this is what I'm doing because I see no other way.

DSW: Yeah. I think that cultural evolution has to be of a very special sort. I think that's what it's telling us. And there's so much more work needed on this. So I think that really, it's only a tiny fraction of people are thinking this way at all. And so much more attention. The more we could just make this basic evolutionary paradigm to become more widely shared, than these wicked problems, and they are indeed wicked. Maybe we'll have a chance of solving them. So to wrap it up, Eörs and Terry, are there any lessons from this concept of major revolutionary transitions that can help us make this final transition to global cooperation, no matter how difficult that might be? Eörs, first you and then Terry.

ES: The Major Transitions, the book that we produced in '95 had these two dimensions. Actually, David Queller even said that it's two books in one. One had this cooperation aspect, how you can form higher level units. And there are many things that come into play there, you must have shared interest, you must have reproductive leveling. The other dimension is information. You need an efficient, integrated information system that actually can be used by any member, any component of the higher level unit to the benefit of the higher level and so on. That's a general lesson. But if you look at the details, this can be achieved in many different ways. And the really difficult transitions happened to be unique. And multicellularity evolved, even the serious version of it, plants, animals, and fungi, evolved three times.

And if you count the multicellular bacteria and everybody else, then it's over 20 times. So somebody even called it the minor major transition, because it doesn't seem to be that difficult. But if you consider the origin of the eukaryotic cell, whereby bacteria came together and the whole cell increased in size, diversified, and now you have a cytoplasm, the nucleus and the thing is 1,000 times bigger in volume

than an average bacteria. There was a time over 100 years ago when people even drew phylogenetic trees where the bacteria and the eukaryotes had independent origins, because they didn't understand how they could be related. Now we know that they go back to one root, but I don't blame those people who were startled. And the late Cavalier-Smith who died about half a year ago was an extremely eminent evolutionary cell biologist, he said if you look at the details of the transitions, there is nothing typical in the details. So the cell had to undergo thousands and thousands of genetic changes in order to make this pass. And out of that comes the actual prediction that something that the eukaryotic cell is no necessity at all in biological evolution. The bet would be that if you will find life on another planets, most of the time you will see that it's something like bacteria, but not something like the eukaryotic cell. There's a major thing and roughly half of the history of the earth was dominated by the bacteria here on the earth as well.

So the point is that if there are difficult transitions, they have many idiosyncratic elements, one building the other. And since I think, we are facing a difficult transition, it also will have idiosyncratic elements, which means that it's almost impossible to predict how it is going to happen. What we know is that we can facilitate that such a thing happen. And it's in the facilitation part, that lessons from the major transitions regarding cooperation, regarding information storage and information use, that is where these things happen, but not in the details because the details will be idiosyncratic and extremely context dependent. And by retrospect, we will see, oh, this step or that step, that was really important, but to foresee, I don't think anybody foresees that. That is what I wanted to say.

DSW: Thank you. That's a very interesting Eörs, thank you. Terry.

TD: So let me begin by going back to something that Eörs said, and that was implicit in work that I was talking about. Which is, natural selection is all work, evolution has to have some play. And we see that in respect to drift, we see that in respect to the production of variation within an organism. Basically the fact that we're all varying versions of each other means that there's enough a relaxation of selection on a whole range, that natural selection constrains the variety, but doesn't determine it. Doesn't push it in one direction or another. And that means that evolution has to have, it's the all work, but no play makes evolution a dull process. Obviously it had to have play. And the play, unfortunately, to be stable, to produce these higher order features, has to somehow balance things. And Eörs mentioned the three major groups that have stabilized this higher order multicellularity— plants, fungi, and animals, they each do so by a kind of biological Rawlsian principle. John Rawls of course, had this idea of a veil of ignorance. That as you come into the world not knowing what kind of a status you will have, and if you can set up a society so that you don't have that predictability, you can't take advantage of it. Well, in effect, fungi, plants, and animals have each found ways to produce the sort of Rawlsian situation, where cells can't be sure that they're going to be the ones that get to pass on into the future, pass their genes to the future. I won't go into the three ways, a fellow named David Buss, in the early 1980s, I think did a nice job of sort of summarizing things of this sort, but how we became moved into this direction. I think it's the result of a kind of addiction.

And as I mentioned before, I think this has to do with once you become codependent, things begin to degrade and once autonomous capacities degrade you're now forced to depend on the stability of the larger group. My own view is that the way that the context has to be set up so that the entire human society moves in this direction, is that in a sense, the codependency has to be so strong that effectively all of the runaway processes that tend to sort of break things down—and I agree with Eörs, I think that the current capitalistic way of making a living, which requires constant growth, you've got to grow in order to survive. This is deadly, ultimately, and eventually we'll of course come to this. And of course, it's not a surprise that every multicelled organism has a maximum size that it finds. That is ,multicelled organisms go through an elaborate growth process in which they're dividing and dividing, they're in a runaway process. And then they stop themselves. We have to be something like an organism.

And I think this is where Teilhard's view of a superorganism might be the right sense, not the sort that for example, in the instance of termites, but one that's more like an actual organism that has a finite size. Those are all interesting, how did they evolve? I think that they evolved in a way that is different than much of the rest of evolution. And I don't think, can either be top down engineered nor that we know exactly what the conditions are that will set this up. But we do know I think, that it only evolves under circumstances of offloading autonomy, becoming coevolutionarily addicted to the larger social group, to being part of a larger social group. I think we can therefore imagine how the global situation can create that kind of a global selection.

So that in effect, it's no longer our group competing against some other group. We're now in a situation where the global situation, creates the kind of selection that drives organism synergy. I do think that's possible. I do think that we might be able to tweak it in that direction. I actually think that the terrible negative things that we're generating now are actually creating that context. So it's a strange way of looking at the threat of nuclear war, the threat of climate disaster, the threat of pandemics of massive, massive proportions. All of these things I actually think are maybe playing a role in this. It's not a role that I think that people will consciously recognize necessarily, where governments will say, okay, we've decided that we're going to cooperate now. That's not going to happen. I think it has to be forced. And it has to be forced from the top end.

Unfortunately, that kind of thing is probably going to be very painful. That is the climate change effects, the nuclear war effects, the biological warfare effects, I think are likely, and they're going to be painful. But I do think that that's the level of selection that will actually work at this because I am a pessimist when it comes to human conscious control.

DSW: It's not so different than Teilhard living through World War I and World War II and the communist revolution kind of saw these as these cultural tectonic plates that were leading to some sorts of futures. And in some passages, he said, this could be thousands of years away, he sometimes said, as opposed to something that we need in the moment. So there's many tensions here, there's many tensions here. There's nothing naive about what we're up against.