THE INTEREST OF REASON IN A WORLD IN EVOLUTION

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Introduction: The character of reason in its evolutionary origin

With the presentation of Professor Manuel Curado the question on the origin and the nature of reason has been placed in an evolutionary framework. This means that the question 'why is there reason?' should be answered by reconstructing the stages of the evolutionary process. Only in this way we can get to know the causes (previous physical and biological states) which produced the emergence of reason. Moreover, the question 'what is the nature of reason and how does it work?' is also the result of an evolutionary study of its origin. We could say that our knowledge of the ontology of reason depends on our knowledge of how it has emerged in the evolutionary process. The same is true of its functions: they depend on reason's ontology and on its adaptive function in order to survive as an instrument of evolution in an objective world.

Curado's presentation also offers a special contribution that could be described broadly as the connection between evolution and epistemology. That is, the characteristics of the idea of knowledge accessible by epistemology (that is to say, the discipline that studies our phenomenological experience of knowledge) are explained in the evolutionary context. Reason (described by its characteristics, such as locality, logical depth, intersubjectivity...) is like it is because of the interest of evolution: the interest of reason is the interest of evolution. This evolutionary origin explains both the shortcomings and weaknesses of reason and the necessary adaptation to an objective world that necessarily imposes its computational constraints. Therefore, all rationality built from within the world must respond to necessary objective constraints that underlie the laws of nature. But at the same time, reason is weak and full of contradictions, walking on the temporary, though history would try to reflect the objective rationality. Manuel Curado tries to show that reason balances between its desire to reflect the objective necessity of computational constraints (in accordance with Minsky's way of thinking) and its weak products, their shortcomings, their «rational constructs», that are perhaps only a possible way to express the objective rationality.

It is important to put this session into the context of the Seminar's discourse:

a) In relation to the contribution of Roberto Poli, Curado extends and complements Poli's point of view. The logic of life (Poli) is the same logic

of evolution (Curado). Life has become an adaptive systems analysis that explains why reason functions as «systems analysis». Therefore life and reason are «anticipatory systems». When Curado speaks of the logic of evolution, he integrates the logic of life that is built on the intervention of Roberto Poli. Curado explains why evolutionary logic (the logic of life) produces epistemological properties of knowledge. Poli focuses on systems analysis and anticipatory systems. Curado extends the evolutionary origin of reason to epistemological characteristics such as location, logical depth and intersubjectivity. The interest of the evolutionary reason for their utility is conditioned by these characteristics dictated by the same evolutionary origin.

b) In relation to the contribution of Walach, it complements and extends Curado's position. Reason is an adaptive tool that has been shaped during the evolutionary process in the light of experience of the objective world. This experience is part of a systemic and structural world that makes reason (as well as life) an adaptive system to a world of systems (Poli) and, as Curado says, of «computational constraints». But not only that. Reason is also a product of the experience of a holistic world, what produces in the mind the adequate rationality to represent the knowledge of that world (Walach). Therefore, Walach proposed a psychological experience (and hence an explanation of reason) conceived within a complementarity principle: firstly, as it is in physics, the classical mechanics and, secondly, the quantum mechanics. In this line should be placed Javier Monserrat's comment to the ideas of Curado, as they attempt to relate the contribution of Curado to the framework of the previous two sessions.

c) In relation to the contribution of Gregor Nickel, Curado defends the evolutionary origin of reason. Formal systems that have been constructed by the human mind arise from the experience of a world of structures with objective necessity. However, Curado does not know why mathematics can be applied to the objective world. We know that its models are useful so far, but we have no absolute assurance. Curado also attributes insecurity, weakness and other shortcomings to the formal sciences, shortcomings which belong generally t-o knowledge because of its precarious evolutionary origin. Up to now we have got these formal systems, but we could imagine other ones that might be more useful for understanding certain aspects of reality. In the discussion of the second session it was raised the possibility that our experience of an indeterministic and holistic world would require new formal systems, not yet designed by the human mind.

I. MANUEL CURADO'S FRAMEWORK PAPER: THE INTEREST OF REASON IN A WORLD IN EVOLUTION

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I. CONTRADICTORY TERMS?

Rationality has emerged in an evolutionary world. This sentence by itself seems to be a blunt contradiction. Saying this more clearly, the word 'rationality' doesn't fit the word 'evolution'. It's not difficult to understand why this seems such a big evidence for many persons. Evolution depends on the casual, on random processes and on time. The structure that we see around us derived from processes that could have not happened. The number of these processes is huge and they seem to encompass the history of evolution.

All this doesn't fit our common understanding of rationality. The most important logical structures, like the logic principles, do not seem to have the possibility of being different. The impression of evidence they impart on us is so strong that is very difficult to imagine that they derived from random processes. More than this, indeed: rationality is a mental modality that claims the truth of its statements about the objects of the world. A true statement is a small world where there is an absolute order. The truth of a true statement evades time and circumstance. As all this is not enough, rationality has a normativity that allows for the imagination of possible scenarios completely different from what we find around us. These small set of characteristics of rationality do not fit our world in evolution.

This is a fascinating problem. We are in need of an explanation of the seeming abnormality of rationality among the structures and properties of human mind. Many other difficult problems are pale in comparison with this one. One can think about the momentous philosophical problem of the relation between subjective experience and biological brains. To know why we feel what we feel instead of feeling nothing, as we were automata, is a problem that was properly labeled as the hard problem of consciousness. However, compared with the explanation of the emergence of rationality in an evolutionary world, the hard problem of consciousness seems surprisingly simple.

Let's see with more detail some aspects of the problem we're dealing with to get a big picture of the issue. Rationality is a characteristic of human beings. As far as one could do a list of traces that are common to all the peoples of the earth, a list we could label as the list of human universals, one couldn't avoid noticing rationality. Let's take as an example of this the famous list of human universals putted forward by Donald E. Brown and published in 1991.

Brown has selected the traces like the abstraction in speech and thought; the fact that all persons in the world do use classification schemes of age, behavioral propensities, body parts, colors, fauna, flora, inner states, kin, sex, space, tools,

weather conditions and many, many other subjects; conjectural reasoning; distinguishing right and wrong; entification or treating patterns and relations as things; figurative speech; interpreting behavior; language (employed to manipulate others, employed to misinform or mislead, translation, language as not a simple reflection of reality, prestige from proficient use of language); numerals and counting systems; semantics (category of affecting things and people, dimension, giving, location, motion, speed, semantic components related to generation and sex); symbolic speech; etc.[1].

This small sample (*sic*) of the big list of Brown's human universals is very impressive. All the peoples of the Earth do have rationality. Thinking in possible worlds, no one knows human persons without rationality or with completely different structures of rationality. This is, precisely, the philosophical problem we're dealing with. How did those structures emerge? Could they have been very different or there is something that prevents the human mind of being otherwise?

Let's try to find the common elements to all these rational structures. Given the diversity of those structures, this is not an easy task. However, we're going to detain ourselves in a few main characteristics. Three traces are especially conspicuous.

The special beings that do own those structures – ourselves – do *not* duplicate the world with perfect mirrors, true representations or accurate pristine maps. Rationality is not a perfect mirror of nature. It's selective, biased and, obviously, is much more simple than the whole of nature itself. Using images to state this more intuitively: human mind is a small world, a compressed world. The highest point and, probably, the most perfect trace of rationality shows this very precisely. Science tries to uncover the laws of nature with compressed algorithms of millions of information units. From data that is the result of millions of observations about the whereabouts of the planets, for instance, a physical law is abstracted. This law is simpler than the observational data and has an algorithmic formulation that states with elegance the planetary movement. With a well-formed law we can reconstruct the precise position of the planets and unfold the observational data. Kepler and Newton, among many others, have showed us how to do so.

What we do have in science we do also have all the time in the human mind. Our categories and classification schemes are very different but they do have this in common: they simplify the world. Human values are very different, but they also have this in common: they simplify the world. Period.

We know that not all natural processes can be *algorithmically compressed*. One can think, for instance, in chaotic systems. In order to understand those systems, one must go along their unfolding until the very end. We cannot simplify our observational data in an elegant formula. Nature has not granted

[1] See Brown, Donald E., «Human universal», in Wilson, R. A. - Keil, F. C. (eds.), *The MIT Encyclopedia of Cognitive Science* (Cambridge MA, The MIT Press, 1999), pp. 382-384; and Pinker, Steven, *The Blank Slate: The Modern Denial of Human Nature* (New York, Viking, 2002), pp. 435-439.

us structures to understand directly this kind of natural systems because – this is a conjecture – that would imply very expensive computational and cognitive resources.

Is it possible that in the vast and enigmatic world of ours there are many other kinds of systems beyond the classic and the chaotic. As far as we know, nature has not equipped us for us to easily pay attention to them and understand their behavior and properties.

Going back to Brown's list, a trace that seems common to all those structures is the fact that they are regional. Saying this otherwise, human mind has the obvious property of *locality*. In order for us to know something, we don't need to know everything in the universe. The way we know something is always local and regional; one could also say, atomic. Of course, one could imagine beings that would need to know everything in order to know something. Hypothetical beings like these could inhabit simpler worlds than ours, worlds without the huge complexity we see around us. In these simpler worlds, to know something would imply to know everything.

Let's state this without ambiguity: the structure of human rationality is connected with the degree of complexity of the world itself. Using a category that belongs to physics and to the complexity sciences, one could say that our world has depth, logical depth. The world had to take many steps to go from the beginning until the level of organization we see around us. If we consider the world as a computational system, this current level of organization would imply time, huge amounts of time, many steps in the between and the progressive abandon of simpler levels.

There's an annoying question about Brown's list of human universals: the reason why our minds have such a big logical depth. Well, things could have been otherwise; we could have had simpler minds. As a matter of fact, as far as we know, animals do have simpler minds. Of course we could also have much more complex minds than ours. For instance, we could have minds without logical paradoxes, minds speedier that our fastest computers, minds without intromission of emotions or bias. Our imagination is the only limit when one considers possible mental structures.

This degree of logical depth of human rationality and of the brain that supports it is an important element for our reflection. It gives us a time reference: the depth of rational human structures could not possibly have arisen randomly in the world. It gives us also a parallel with the level of organization we see in nature around us. There are no obvious discrepancies; we do have rationality with a precise level of logical depth and we live in a kind of world with a parallel level of logical depth. Finally, we are before a very interesting counterfactual scenario: human rationality could be much simpler and also much more complex than it actually is, and our world could also be much simpler and much more complex than it currently is.

Let's return to our initial problem: How can we explain the emergence of rationality in a world in evolution? What must we precisely explain? These aspects

seem to me the most relevant: algorithmic compression, locality of our knowledge and the degree of logical depth. Is this enough?

These characteristics could exist even if evolution has allowed for the existence of a unique rational being in some places in the universe. This is clearly a very imaginative scenario because we don't have the faintest hint that that has happened in some other place in the universe. The evolutionary process that unfolded on Earth has not just *one* single agent; on the contrary, rationality is disseminated over all agents there are, especially the most basic aspects of it.

Let's add, then, a fourth property to the already mentioned three. This property could be labeled, in the absence of a better name, the *multiplicity of rational agents*.

II. The Red Button

Let's try to describe this rational multiplicity in a more intuitive way. The very fact that rationality is present in a multiple agent scenario helps us to understand its ultimate value. When we mentioned algorithmic compression, locality and logical depth we were very close to an anthropic perspective, the idea that the universe has unfolded itself in such a way that it allowed the emergence of rational observers. This nice idea cannot be proved because it has a teleological bias that is dissonant with everything else we know about the rest of evolution. It's important to refuse any intromission of the anthropic principle in this debate. The teleological approach overstates the most perfect aspects of rationality. On the contrary, the multiplicity of rational beings shows us imperfection, impotence and incompletude. Rationality is not only the most beautiful collection of mankind's highest achievements; it's also the problematic collection of permanent underachievements and very humiliating ones.

There are many ways to show that human rationality is imperfect. Ever since the ancient Greeks the list of imperfections is very long. One recalls famous tales about paradoxes, the famous arguments about *akrasia* or weakness of the will, and the also famous denunciations of the role of emotions in the rational life. More recently, with the debate around what can and cannot be proved inside each formal system, we have continued the description of rationality's own limits. All this is very well documented.

It's important to draw our attention to the limits of rationality derived from contextual aspects. What does this mean? If one considers rationality as part of human nature in evolution, one should have an instrumental notion of its effective value in helping beings that live in community. It's not correct to imagine a lone being making perfect sequential calculations. Human rationality in action doesn't function that way. To get a notion of what we're dealing with, a really limited structure is a precious result. Everything concerned with rationality creates the strong illusion that reason has no imperfection or limit. Logical principles, schemes of classification, intersubjectivity, normativity, the claim for true and

non subjective statements and the capacity to refer to objects outside human beings work in unison to create an impression that the wonderful building of rationality has no cracks, no imperfections.

Let's think for a moment in one possible variation of the wolf's dilemma described a few years ago by the cognitive scientist Douglas Hofstadter[2]. I'll call this variation the red button dilemma. I'll try to amplify Hofstadter's original dilemma.

Let's imagine that there is a red button inside a room. Some big buildings do have fifty rooms. All fifty rooms have a red button. We choose randomly in the street fifty persons that do not know each other and that are completely unable to see or communicate with each other. We'll tell each one of the fifty persons the following: «if you want to win one thousand euros, you just have to stay inside one room during ten minute and not press the red button. If one of the other forty nine persons do press the red button for whatever reason, that person solo will get one hundred euros and nobody else will get any money».

The rules of this experience are very clear and all of us do understand what is implied in this situation. Allow me an interpretation. This experience is a perfect portrait of our world: it has many persons; persons are different from each other; some are clever, others not so; some are young, others less young, etc. If we were the inhabitants of an intelligent and exclusively rational world, all the fifty persons would let the ten minutes pass and would get each one one thousand euros. However, in this world of ours that is not what happens.

Because we are different from each other and we don't know for sure what's going on in other persons' minds, our experience shows that there is a strong temptation for someone to press immediately the red button. In our world the rule is this one: *the smarter you are, the dumbest you decide*. The more intelligent persons are precisely those than understand in the first place that they should press the red button as soon as possible.

For one to understand that there is no way to win this red button situation, one could do some improvements of our original random selection of persons. Let's suppose that in one of the rooms we put someone extraordinarily intelligent, let's say, a Nobel Laureate in Physics or Medicine, whatever. There's no doubt whatsoever about the outcome: that person, precisely because he's very intelligent, would be the first one to press the red button. That clever person would do the less clever thing possible.

And what would happen if in one of those fifty rooms there were one hundred geniuses with Nobel prizes and Fields medals? With all probability, that room would press the button in the first place.

We were educated with the conviction that there are always authorities that can help us to understand difficult issues: ministers, priests, rabbis, psychoanalysts, politicians, judges, scientists, king philosophers… Well, we can choose our favorite King Solomon as a model of wisdom. But we must remember

[2] Hofstadter, Douglas, *Metamagical Themes* (New York, Basic Books, 1985), pp. 752-53.

this: even if we put our most wise King Solomon in one of the fifty rooms, he won't decide better than we do. This is incredible! *We live in a world where wisdom is irrelevant in many situations.*

Most of the times we don't have a precise notion of what rationality is worth of because, for reasons connected with our intellectual history, we tend to imagine that each of us lives alone in the world as the Little Prince of Saint-Exupéry. We think rationality in the scenario of single agents and not in the scenario of multiple agents.

The red button dilemma shows us the fundamental frailty of rationality. The very nature of this frailty in contextual: it depends on the number of the persons involved, on communication and on the impossibility of communication to access other persons' point of view.

A very interesting aspect of this frailty is quantitative. Notice this: the rational capacity of the person inside one of the fifty rooms doesn't help her or him to solve the problem, even if that person were preternaturally superior or smarter. Can we generalize this feature? I think we can. Those big rational capacities seem to be useless in our world. Being fair for those hypothetical smarter persons, we could say that those persons do understand many important things: they categorize correctly the objects, they differentiate their own persons from the objects that stand around them, they do understand the general features and rules of the situation they're inside of, and they do have rational preferences (they prefer to get more to get less, they prefer to get something to get nothing, they prefer this brand of beer to other brands, etc.).

How can we understand this awkward situation?

Let us notice in the first place that the persons inside the rooms do have a rationality that can be described with the properties we mentioned before. It's obvious that the way those persons think is algorithmically compressed; they select sequentially aspects of the situation according to what they consider to be relevant; the color of the walls is not relevant, so nobody mentions it and that feature stays out and unmentioned.

It's also obvious that reasoning is local. In order to find out what to do during the ten minutes is not necessary to take into consideration, for instance, the history of Europe since the Roman Empire. The choice one must take is local; what is relevant is local; and the rational process only takes into account the small world of the situation.

Finally, it's important to notice that rational activity of these persons shows the logical depth of the situation. It would be very improbable that the history of the universe had started with a scenario like the red button dilemma and not with something apparently simpler like the Big Bang. As a matter of fact, one of the handicaps that persons deal with is the lack of previous information about the other forty nine persons involved. What is that person in need of from the point of view of logical depth? Clearly, he misses information about previous states of the system, namely biographical information about the other persons involved.

These three properties are all present but do not help much in a situation where there are *many* rational beings. Any of these properties would be perfect if the world had just one person or agent. Human beings are not like that.

We have, then, a very unsatisfactory result that gives us a quantitative point of view about what's our rationality is worth of.

The failure of each of those persons isn't total. Each of them does understand the situation and the utter impossibility of doing any better. Those persons stand, then, in the very middle of a scale: neither are they completely stupid nor completely intelligent. They are in the middle of a scale; likewise they are in the middle of the scale of algorithmic compression, in the middle of the scale of locality and in the middle of the scale of logical depth.

It's possible, then, to interpret positively the limits the red button dilemma shows us. These limitations denounce the computational geography of our world. Please notice the following scenarios:

Scenario Number One. We could have been a kind of beings with just *one* type of subjective sensations (for instance, the content of the taste of coffee, or the content of smelling vanilla ice-cream). Fortunately, we have more than one type but we fall short of an astronomical number of types of subjective experiences; it seems than we have precisely the correct number: not too small, not too big.

Scenario Number Two. It's a remote possibility that all of us could be beings that speak just a single language; or, at the other side of the spectrum of possibilities, each one of us could speak a private language unknown to other persons. As far as we know, there were at least seventy billions persons on this planet, and we could have spoken precisely than number of languages, each person with his or her own language. As we know, there are more or less just six thousand human languages on Earth. One more time, our predicament is a situation where we have neither too little, nor too much; we are always in the middle of a scale of possibilities about human languages.

Scenario Number Three. Please do notice that we can describe this point as a universal rule of translation. If we have languages too poor lexically, it's hard to find terms to refer objects common to two languages. In order to get a good translation, one must work with languages with rich vocabulary. If the logic of this argument is correct, translation demands languages with increasingly higher numbers of terms of vocabulary. The translation, say, between Basic English and Basic Portuguese is not satisfactory. However, if the total number of vocabulary terms of English would amount to billions, the rational resources of a translator would not be enough to check the whole vocabulary set trying to find the precise match for a translation of a precise word. The return would be shorter than the investment or even inexistent. For one to get a proper translation, one needs a lexical set neither too small, nor too big.

Scenarios Number Four and Five. The computational constraints that the red button dilemma and translation tasks show us are present in many other domains. The list is overwhelming. Think, for instance, in the sensorial stimulation

according to the nineteenth-century Weber-Fechner's law, and in economic situations where the law of diminishing returns applies.

We have here computational constraints that describe precisely the rational limits of the persons that stand inside the fifty rooms of our dilemma. The multiplicity of rational agents is, therefore, an important characteristic to understand the origin of rationality. It localizes rationality inside the computational geography of our world and shows us that we are not trying to understand a private matter, or a subjective matter, or even a human matter. We're trying to grasp the very computational geography of the world, with rational human beings or with finite rational beings that could exist somewhere else in the universe, as Kant could have said.

III. Is Rationality an exclusively human trace?

We have right now a strong suspicion. It's this one: what rationality seems to show does not match its effective results. We have no way to decide correctly in a world that is properly represented by the red button dilemma. We can fill in a vast list of instances of reason's shortcomings: we have no general problem solver, no universal translation algorithm, no idea of how to solve the problem of reference, human creativity is the source of everything we deem precious but we cannot understand the logical structure of creativity itself. I stop at this point because the list of reason's shortcomings is indeed very long, and probably is endless. We can, obviously, make a parallel with the greatest hits of rationality, and it would be good to do that in order to get a balanced perspective of the whole issue.

Human rationality has a difference of degree but not of kind in relation to the rationality of other species. During the nineteenth-century, Darwin provided us with the will to understand how characteristics that seem to belong exclusively to humans are in simpler forms in other animals, namely language, subjective consciousness, mating and courtship, and, of course, rationality.

The agenda that tries to naturalize reason had with Darwin one of its highest points. In *The Descent of Man*, Darwin wrote these truly amazing words: «Of all the faculties of the human mind, it will, I presume, be admitted that Reason stands at the summit. Only a few persons now dispute that animals possess some power of reasoning. Animals may constantly be seen to pause, deliberate, and resolve. It is a significant fact, that the more the habits of any particular animal are studied by a naturalist, the more he attributes to reason and the less to unlearnt instincts» [3].

This agenda has been so successful that we now are trying to find the evolutionary origins of human rationality. The studies with unicellular and simple beings are, perhaps, the most impressive to start with. One recalls the studies about the calculation skills of fungi, about the intelligence of swarms

[3] Darwin, C., *The Descent of Man* (1871), p. 75.

and about the phenomenon of quorum sensing that was discovered by the biologist Bonnie Bassler of the University of Princeton [4]. It's useless to dare to mention many studies about other superior animals, like simians.

How can we understand these amazing results? Well, in the first place, in the evolutionary series we belong to human beings share rationality with other beings. The philosopher Max Black has described this situation in a celebrated article with the title «Why Should I Be Rational?» as the minimum rationality or compressed reasoning that is present in both humans and the other animals [5]. The structure of common uses of reasoning includes interpretation of perceptive signals, the fitness of behavior to situations and the anticipation of future events.

Notwithstanding this result, there is another one much more impressive. For many centuries there have been philosophical theories that state that reason cannot be naturalized. We're living in an extraordinary epoch in which we do have the intellectual resources to look at this question with confidence. Now we can state, against the American philosopher Hilary Putnam and many others, that reason can indeed be naturalized [6]. We're learning nowadays the correct way of doing this.

IV. Hypothetical and finite rational beings

Let's assess what we have right now. In the first place, we have this justified belief that rationality in not a lone and remarkable exception of the human mind, and that, therefore, it's also present in other living beings.

The question we must ask is whether rationality, as we know it (magnificent but strangely incomplete in human beings, at a minimum level but very robust in animals), is an accident in the evolutionary history of Earth or an inevitability in the universe.

Please notice that this question is not as exaggerated as it seems. The laws of nature that science has already discovered show a universe that can be understood, or partially understood, with laws that abstract an algorithmically compressed statement from the complexity of the world; a universe characterized

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[4] About calculating fungi, see Nakagaki, Toshiyuki - Yamada, Hiroyasu, «Maze-solving by an amoeboid organism», *Nature*, 407 (28 September 2000), p. 470. About *quorum sensing*, see Bassler, Bonnie L., «Tiny conspiracies», *Natural History*, 110: 4 (2001), pp. 16-22; Strauss, Evelyn, «A symphony of bacterial voices», *Science*, 284 (05/21/99), pp. 1302-1305; and Ben-Jacob, Eshel, *et al.*, «Cooperative self-organization in microorganisms», *Advances in Physics*, 49 (2000), pp. 395-555.

[5] Black, Max, «Why Should I Be Rational?», *Dialectica*, 36: 2-3 (1982), pp. 147-168. See also Davidson, Donald, «Rational Animals», *Dialectica*, 36: 4 (1982), pp. 317-327.

[6] The case in favor of the idea that reason cannot be naturalized can be found in Putnam's Hilary, «Why reason can't be naturalized», in *Realism and Reason. Philosophical Papers*, vol. 3 (New York, Cambridge University Press, 1983), pp. 229-247. Recent studies about the cognitive and societal structures of rationality are summarized in Leda Cosmides' article «The logic of social exchange: Has natural selection shaped how humans reason? Studies with the Wason selection task», *Cognition*, 31 (1989), pp. 187-276.

by logical depth; and a universe that seems local (what happens in one place doesn't propagate to the entire universe).

There's no doubt that we're stepping on a very demanding ground. If we enlarge this search for signals of rationality to hypothetical beings outside Earth, we'll be in serious problems. No one in the scientific community knows those beings or whether they are possible at all. This imaginative exercise is purely methodological. Trying to imagine those hypothetical beings is a way to try to understand human beings' rational constraints. Kant's concept of potential finite rational beings is an important philosophical precedent. Many Kantian arguments try to find a truth that imposes itself on human rationality and on the rationality of sundries rational finite beings that there may exist somewhere else.

The very existence of difference is a fact of life. We don't need other beings for that. It's possible, not only to imagine sentient beings with other phenomenic content or with other perceptive modalities; it's possible, say, to find real human beings with damage done to their perceptive or mental faculties.

However, differently from other structures of human mind, rationality doesn't seem to be able to be otherwise. Human rationality is a blend of computational constraints and evolutionary situations. The argument here presented contends that this blend is common to other aspects of human mind as well, namely language, subjective experiences, and many others.

Let's pay attention to this *incapacity of being otherwise* [7]. A few years ago the MIT computer scientist Marvin Minsky described a delightful possible communicative situation with alien rational beings [8]. Minsky's question was this one: Is it possible to communicate with hypothetical alien beings with higher intelligence, or, at least, with intelligence very different from our own human type of intelligence?

This question about the possibility of communication with hypothetical aliens is really an enquiry about the ultimate nature of rationality of human beings. Minsky places rationality in the right context, the evolutionary nature.

The result he obtains is very interesting: the possibility of variation of the most basic structures of rationality is very narrow, as if human beings, other biological beings and even hypothetical aliens were limited by common computational constraints. From a philosophical point of view, this result is correct because it draws very heavily from two important sources: evolution theory and computational constraints.

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[7] There are other ways of exploring this incapacity of being otherwise. The Brazilian logician Newton Da Costa explored the possibility of other rational structures in human societies; see Da Costa, Newton - Bueno, Otávio - French, Steven, «Is there a Zande logic?», *History and Philosophy of Logic*, 19 (1998), pp. 41-54; and Tripplett, Timm, «Azande logic versus Western logic?», *British Journal for the Philosophy of Science*, 39 (1988), pp. 361-366.

[8] Minsky, Marvin, «Why intelligent aliens will be intelligible», in Regis, Edward, Jr. (ed.), *Extraterrestrials: Science and Alien Intelligence* (New York, Cambridge University Press, 1985), pp. 117-128.

As a matter of fact, Minsky is not interested in aliens or in animals or, even, in human beings. The category that is common to all these kinds of beings is «general problem solver». From this point of view, «all problem-solvers, intelligent or not, are subject to the same ultimate constraints – limitations on space, time, and materials». Finding a way to cope with these constraints implies finding a way to represent situations and processes to manipulate those representations.

What is impressive in Minsky's paper is the powerful idea that evolution finds necessarily certain common ideas because, putting this in a straightforward manner, there are no easier ways available.

The main ingredients of intelligence, that hypothetical aliens must also use, are the objectives, and sub-objectives, goals, and sub-goals, cause-symbols, memories, economics, planning, self-reference or self-awareness, and just a few others.

The very core of this theory is the notion that the emergence of rational structures was inevitable. 'To evolve' means in this context to search inside a universe of possible structures. Now we can answer a very old question about the amazing human capacity to understand the world humans inhabit. And the answer to this question is that rationality in not an abnormality in the evolutionary world but shares with evolution common principles of economics, sparseness and computation. Saying this more to the point: computational constraints are common to nature and to thought. Rationality is not, therefore, an evolutionary accident alongside many, many others, in spite of the fact that evolution as a whole is an astronomically big collection of random events and accidents. These accidents occur only in the small details because the overall logic of evolution imposes itself on all processes.

There are, of course, a few problems with this Minsky's theory. The first one is, obviously, the conviction that the human brain in a universal Turing machine. Nobody is sure about this point, and it's possible that the most interesting rational processes, like creativity in general and mathematical creativity in particular, or the ability to feel subjective experiences, cannot be described according to the notion of Turing machine.

Another difficult point concerns the supposition that all parts of reality organize themselves with computational processes. For instance, nobody is sure about this point in what concerns the microphysical realms. (For the sake of the argument, we can emphasize that biological evolution happens on complexity levels very different form the complexity level of microphysics.)

In spite of being a truly remarkable theory, the ideas advanced by Minsky have many limitations. However, it must be said that it's a powerful tool to understand the most difficult aspect of rationality. As we said before, rationality is a rather special part of the human mind. Its amazing ability to produce true statements about reality frees itself from the orbit of subjectivity.

In this sense, an explanation about the origins of rationality demands an enquiry about the very essence of that surprise that many philosophers, or scientists with philosophical minds, expressed when they noticed the eerie ability

of rational thought to represent nature. One thinks, among others, in the famous essay about «the unreasonable effectiveness of mathematics in the natural sciences» written by the physicist Eugene Wigner; or the mathematician R. W. Hamming's essay about «The Unreasonable Effectiveness of Mathematics» [9].

This is, indeed, a huge problem. If the human mind were exclusively subjective, one could say that we are beings interested only in our own issues, in our own interests. However, precisely because reason seems to have a structure amazingly homologous to the computational structure of our world, it's possible that human reason has an interest of its own.

This reason's own or selfish interest may or may not be identical with the overall human interest. This is a very rare suspicion because we tend to identify ourselves with the representation reason has made for us. We don't trust the interests of other parts and structures of the human beings; we don't trust, for instance, our craving for sweets; we don't trust the feeling of jealousy; we don't trust our own will when it is under temptation; we don't trust the ability of the human brain to solve problems without solution with thousands of years; we don't trust common perceptive illusions; sometimes, we don't even trust the strength of our faith; we don't trust caprice, childlike caprice or feminine caprice, for instance; we don't trust hitches; the list is indeed very long. So, why should we trust our own reason? It's a good question, isn't it?

V. A Conjecture

Let's finish this paper with a very imaginative conjecture. Without any ambiguity, is important to state clearly that there is no way of proving it. As a consequence, one can feel free to interpret it as a literary or philosophical suggestion. The conjecture is the following. *Step Number One*. Human rationality has a structure homologous to the computational structure of reality; we can verify this with a few concepts derived from Physics or from the Sciences of Complexity, namely, algorithmic compression, locality, logical depth, and Turing machine properties, or with the biological concept of Darwinian evolution.

Step Number Two. Human rationality seems to be an unfinished building, because it offers us both true statements about reality and a cohort of paradoxes and constitutive problems.

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[9] See Wigner, Eugene P., «The unreasonable effectiveness of mathematics in the natural sciences», in *Symmetries and Reflections* (Woodbridge CT, Ox Bow Press, 1979), pp. 222-237; and Hamming, R. W., «The Unreasonable Effectiveness of Mathematics», *The American Mathematical Monthly*, 87: 2 (February 1980), p. 81. See also Davies, P. C. W., «Why is the Physical World so Comprehensible?», in Zurek, Wojciech H. (ed.), *Complexity, Entropy, and the Physics of Information* (Reading MA: Perseus Books, 1990), pp. 61-70; and Omnès, Roland, *Converging Realities: Toward a Common Philosophy of Physics and Mathematics* (Princeton NJ, Princeton University Press, 2005).

Step Number Three. We know that rationality emerged in a precise evolutionary sequence we call 'our universe', and, as far as we can see, is part of the observable universe because this universe can be explained using rational natural laws.

Step Number Four. It's possible that rationality seems unfinished to us because we don't have yet the big picture of the universe; taking notice of the physical theories of the Swedish physicist Max Tegmark and other Many Worlds Interpretations of Quantum Mechanics, it may happen that our world is not part of a universe but part of a multiverse where all conceivable possibilities do indeed exist [10]. From this point of view, the rationality we own as a tool or as the true picture of our face (pick the possibility you prefer, I'll keep the first one, rationality as a tool) is just a regional characteristic of an evolutionary sequence; many other types of rationality could exist in many other universes of Tegmark's multiverse.

I hope this conjecture turns out to be true.

II. SESSION PROCEEDINGS

Presentation

After a brief presentation of the Sophia Iberia Project and its First Academic Seminar by Christine Heller, who acted as moderator of the first part of this session, Prof. Curado began his presentation:

Contradictory terms

Human beings and all natural things that surround us have developed by evolution, depending on a huge number of random processes which could have not occurred. On the other hand, rationality is ruled by logical principles which do not seem to have the possibility of being any different. This contradiction makes it a hard problem to explain the emergence of rationality in an evolutionary world.

Rationality is one of the universal human characteristics (a list made by Donald E. Brown in 1991 [11] was partially read). Curado highlights the following common elements among the rational structures of the different peoples on Earth: 1. Rationality does not duplicate the world, but acts selectively, in a biased and simplifying manner. As we see especially with science, rationality tries to find an **algorithmically compressed** way to duplicate most natural processes. 2. **Locality** is another common characteristic to our rational structures, that is

[10] A bright and funny introduction to Tegmark's ideas can be found in Chown, Marcus, *The Universe Next Door* (London, Headline Book Publishing/Review, 2003).

[11] See Brown, Donald E., «Human universal», in Wilson, R. A. - Keil, F. C. (eds.), *The MIT Encyclopaedia of Cognitive Science* (Cambridge MA, The MIT Press, 1999), pp. 382-384.

to say, in order for us to know something we don't need to know everything in the universe. 3. Human rationality has a high degree of **logical depth**. The world we live in has a parallel level of logical depth. 4. It is also important to take into account the **multiplicity of rational beings**.

The red button

Prof. Curado refuses to consider the teleological argument usually called the anthropic principle, because in his opinion it is dissonant with everything we know about evolution and because this approach overstates the most perfect aspects of rationality. He also wants to take into account the imperfection, impotence and incompleteness coming from the multiplicity of rational beings and, without forgetting rationality's highest achievements, the many humiliating shortcomings of its use by mankind.

The imperfections of human rationality have been shown since old times in famous paradoxes, and the bad influence of our emotions and our weak will in our minds have also been always deplored. Some of its limits have been confirmed in more recent studies about what can and cannot be proved within formal systems. Other limits derive from contextual aspects. In order to describe them in a more intuitive way, Prof. Curado presented the red button dilemma (a variation of Douglas Hofstadter's wolf's dilemma)[12] to the audience.

We have fifty rooms with a red button in each one of them. Fifty people, chosen randomly, are put in these rooms unable to communicate with each other. They are told that if none of them presses his/her button in ten minutes, everybody will be given one thousand euros per person, but if one of them presses his/her button and nobody else does, that person alone will receive one hundred euros, and the rest will receive nothing. The rational thing to do would be that everybody waits ten minutes without pressing any of the buttons, but that is not what happens. Usually there are some people (the smarter ones) who try to press the button as soon as possible, because they don't know for sure what's going on in the others' minds. In Curado's opinion that would be in agreement to a common rule in our world: the smarter you are, the dumber you decide. In fact, we live in a world where wisdom is irrelevant in many situations.

We usually think rationality in the scenario of a single agent and not of multiple agents. In the red button dilemma we discover a contextual limitation of rationality: the number of persons involved and the impossibility of communication among them causes a deficiency in the rationality of the decisions taken. The contextual difficulty makes it irrelevant if the individuals are very intelligent or not. This result makes us realize why big rational capacities seem to be useless in our world. Even if their rationality works flawlessly, with is typical characteristics of algorithmic compression, locality and logical depth, these three properties are not of much help because the missing information

[12] HOFSTADTER, DOUGLAS, *Metamagical Themes* (New York, Basic Books, 1985), pp. 752-53.

about the other persons is decisive when multiple rational beings are involved. Those properties would be perfect if the world had just one rational agent, but that's not the case.

The fifty people involved are able to use the characteristics of rationality in a middle scale, thus the red button dilemma shows us limitations that denounce the computational geography of our world, that is to say, situations where we are at best when the possibilities are not too many nor too less. Prof. Curado then explored a few possible scenarios concluding the following: 1. We have the correct number of subjective sensations, not too small, not too big. 2. There is a good number of languages in the world, not just one for everybody nor (what would be a nightmare) one different language per person. 3. For a good translation it is better to work with languages that have rich vocabularies, but not enormously big. 4. These computational restraints are present in many other domains, such as sensorial stimulation and economic situations. He finally concluded that the multiplicity of rational agents is an important characteristic to understand the origin of rationality.

Is rationality an axclusively human trace?

Our rationality is able of great achievements and also has important shortcomings. In other animal species we find a different degree of rationality but not a difference in kind. Scientists since Darwin have discovered numerous animal behaviours that can be attributed to reason. And so, we now are trying to find the evolutionary origins of reason. The structure of common uses of reasoning includes interpretation of perceptive signals, fitness of behavior to situations and anticipation of future events.

Hypothetical and finite rational beings

Rationality, as we know it, is present not only in humans (magnificent but strangely incomplete) but also in other living beings (at a lower level). The question is if this rationality is an accident in the evolutionary history of Earth or an inevitability in the universe. This latter possibility is well supported by the fact that science has discovered a universe that can be (at least partially) understood with algorithmically compressed laws, a universe characterized by logical depth and that seems to be local (what happens in one place doesn't propagate to the entire universe).

Prof. Curado considered then, as a methodological exercise in order to understand rationality's constraints, the imagination of hypothetical rational beings outside Earth. Kant did something similar attempting to find a truth that imposes itself on the rationality of any potential finite rational being. Without so much effort, in our own world we find differences everywhere, so that it's possible to find real human beings with damage in their perceptive or mental faculties. However, rationality doesn't seem to be able to be otherwise. Human rationality, like other aspects of the human mind (such as language, subjective

experiences, etc.), is a blend of computational constraints and evolutionary situations.

Computer scientist Marvin Minsky [13] also questioned a few years ago the possibility to communicate with hypothetical alien rational beings; his attempt being just an enquiry about the ultimate nature of rationality in the correct context of evolution. He concluded that the possibility of variation of the most basic structures of rationality is very narrow. All possible rational beings could be considered just «problem solvers». From this point of view «all problem-solvers, intelligent or not, are subject to the same ultimate constraints – limitation on space, time and materials». Coping with these constraints implies representations and a way to manipulate them. Evolution would find necessarily certain common ways because there are no easier ways available. Main ingredients of intelligence, also for hypothetical aliens, would be: objectives, goals, cause-symbols, memories, economics, planning, self-reference, self-awareness and just a few others.

'To evolve' means to search possible structures inside a universe, with the principles of economics, sparseness and computation. These principles have something to do with the computational constraints that are common to nature and thought. Rationality is not, therefore, an evolutionary accident. The enormously big number of random events that produce each evolutionary step occur only in the small details because the overall logic of evolution imposes itself on all processes.

Some problems with Misky's argument are: 1. The human brain is assumed to be a universal Turing machine, and some processes (such as creativity) cannot be described in those terms. 2. It has also been assumed that all parts of reality organize themselves with computational processes, and there are big doubts concerning the microphysical realm.

Despite these limitations, this argument is a powerful tool to understand the most difficult aspect of rationality: its amazing ability to truly represent nature. Reason reaches beyond the strict subjectivity and seems to have a structure homologous to the computational structure of our world. Prof. Curado finished this line of thought with an observation followed by a question: Curiously we tend to distrust almost all instances of our person (feelings, perceptions...), why should we trust our own reason?

A conjecture

To conclude his presentation Prof. Curado proposed the following conjecture, as a literary or philosophical suggestion (because there is no way to prove it): 1. Human rationality has a structure homologous to the computational structure of reality (in reference to the characteristics of rationality already mentioned above and the concepts of Darwin evolution). 2. It seems to be unfinished, because

[13] Minsky, Marvin, «Why intelligent aliens will be intelligible», in Regis, Edward, Jr. (ed.), *Extraterrestrials: Science and Alien Intelligence* (New York: Cambridge University Press, 1985), pp. 117-128.

it offers both true statements about reality and a cohort of paradoxes and constitutive problems. 3. It emerged in the precise evolutionary sequence that constituted our universe, being part of it (because this universe can be explained using rational natural laws). 4. If our world were part of a multiverse (Max Tegmark), where all conceivable possibilities exist, then our rationality would be just a regional characteristic of an evolutionary sequence (thus explaining its apparent imperfections); many other types of rationality could exist in the other universes of the multiverse.

First answers

Christine Heller, *how crucial is natural language for rationality?*

Christine Heller: Concerning the possibility of each person in the world having a different language, she mentioned that in earlier sessions natural language had been considered as something very close to reason, especially their metalanguage. She asked then, how crucial natural language itself is for the type of rationality we seek to explain.

Manuel Curado affirmed that language is a powerful tool to understand the world around us. But he wanted to highlight the sheer impossibility of dealing with a perfect language (with enormous vocabulary, grammar, rules...). One could imagine other beings having other resources, being perhaps able to manage and translate languages with billions of terms, but this would be impossible for us. So, it's important that our languages have many possibilities but not too many, that we have many languages but not so many that it would be impossible to communicate. The point is that our natural languages are powerful but incomplete tools, as everything else in our lives (including rationality).

Ignacio Núñez de Castro, *we must use our rationality to explain rationality.*

Ignacio Núñez de Castro asked if it is at all possible to explain what rationality is. Because in order to explain it we have to use as tool precisely our own rationality.

Manuel Curado admitted that this situation makes it very tough, as it's a bad logical option to explain rationality with rationality itself. But we can make a detour, and find monotony, the same structures, the same computational constraints happening in many aspects of the world (as the problem of translation or in economics). We can make a big list of structures with computational constraints. Of course we are able to do it because of our rationality.

Javier Monserrat, *are computer models appropriate to understand our world?*

Javier Monserrat said that in principle we can distinguish between natural objects, such as rocks or human beings, and artificial objects, such as computers. But it is a fact that cognitive sciences consider computers as a model to understand living beings, and the human brain, for example. He asked the speaker whether he thought that this computer model is appropriate to understand the physical world or not.

Manuel Curado mentioned Stephen Wolfram's book *A new kind of science*, where the author defends that with cellular automata we can describe natural processes, objects and everything around us, even physical laws. But he stated that from a philosophical point of view this is impossible: computers, automata etc can be used as powerful models

but are very insufficient to understand reality itself. However, computation has no limits; we haven't discovered yet the end point, the threshold of computation; amazing computational models are still being discovered, such as the recent research on quantum computing. Of course, that kind of model is not enough to describe the amazing variety of biological beings, the beautiful universe around us. But our goal is not to just make models, philosophical or mathematical models, we are doing something else: the cartography, the most perfect map of reality. Our world has a computational geography; we can interpret Darwinian evolution and most parts of biology, chemistry, the world of galaxies... as a sequence. We can diagnose this common pattern, the sequence of everything, which is very complex. As it happens in all aspects of our lives we find it is very improbable to find this degree of complexity from the beginning, from the first step of anything. We find the complexity only after many steps. What we are looking for is a description, a cartography of our world.

III. DEBATE WITH MANUEL CURADO

Javier Monserrat, acting as moderator, first thanked Manuel Curado for his presentation and valuable contribution to the Sophia-Iberia Academic Seminar. He offered then a reflection linking both previous two sessions and addressing at the end a few ideas from Curado's earlier talk. He has since developed all these ideas in a thorough contribution that can be read below. After his thoughtful participation the moderator opened the floor for questions from the audience.

Javier Leach (Computer Sciences, U.C. Madrid): ***Evolution of human reason is shown in evolution on mathematics and computers.***

Javier Leach commented about evolution of human reason in relation to the evolution of Mathematics. First step: when mathematicians had not enough producing algorithms but wanted a proof of these algorithms, and that was firstly achieved (more or less) by the Greeks (Egyptians knew important theorems but could not prove them). This step shows a strong rationality, the ability to proof that an algorithm is correct. A second important step came at the end of the 19th century, and that is the complete formalization of the language (although Aristotle had already begun to formalize the language). It permits to speak rationally about the language, using Meta-mathematics. This process of formalization has been very strong during the 20th century. But today we can do that with computers in three minutes. This is an historical milestone, humanity has achieved this complementarity of computing (formalism) and evolution. What we have achieved, we can then transmit through the computers.

Manuel Curado said we are completely unable to prove that this is not just a coincidence. Is development of mathematics really relevant for our understanding of the ultimate nature of rationality? How can we prove that the structure of rationality in ourselves is more than a beautiful set of skill and tools and does meet the structure of the universe out there? We are utterly unable to prove this point. The historical development of mathematics is impressive, but maybe other peoples on this Earth have different mathematical histories. A few years ago Brasilian Logician Newton da Costa published a paper entitled *Is there a Zande logic?* The Zande, a people from Africa, are supposedly

able to keep contradictions in their own minds. Is it possible that other peoples on this Earth can have a completely different structure of rationality, one that encompasses contradictions, that accepts paradoxes? It seems interesting but in our world it is impossible to have a different logical structure. History of mathematics is relevant, perhaps the main chapter of history of science, alongside physics. But, is it possible to prove that the mathematical structure of our rationality matches the enigmatic universe out there. The big problem is whether we have the ability to prove that there is a match between our logic and the deep structure of physical reality.

Alfredo Dinis (Philosophy, U.C. Portugal): ***Rationality, emotions and natural selection.***

Alfredo Dinis commented first about the relation between rationality and natural selection. That natural selection occurs for adaptive reasons, giving the organism advantages for survival, has recently been doubted and debated. The question is if reason is a result of natural selection or not. And if reason is not the result of natural selection, then of what?

Then he commented about systemics and holistic analysis, bringing to attention the concept «extended mind», the idea that mind is not all inside our brains. But then what are the consequences of this view of extended mind for rationality, because it extends beyond our brains to the outside, for instance to a notebook? Memories being kept on a paper is not the same as in the brain. Now, does it mean that reason and rationality step beyond human mind?

Another comment concerned the dualistic view of human beings, having both emotions and reason. There is some inner debate between emotions and reason. And emotions are often considered to have their own reasons. But then, would it be better to have only rationality and no emotions? If reason was selected by natural selection, as an advantage for survival of mankind, how is it then that mankind's rationality is constructing nuclear weapons, something that could have the effect of erasing all advantages of mankind?

Manuel Curado appreciated the depth of Prof. Dinis' questions and began commenting on the shortcomings of rationality. The question is 'can we prove how rationality emerged in an evolutionary world?' Paying close attention to the shortcomings, handicaps, faults and impotence of reason, we see they are constitutive of reason itself. Evolutionary psychologists have recently shown that our rationality is especially good when dealing with social situations, and especially in problematic situations. If our rationality is indeed biased by social contents, then the structure of our reason is not a perfect structure. We have a frailty that depends on evolution, that has emerged in a peculiar situation in the past of evolution. Not only in relation with social contents, but also concerning paradoxes, warfare, the consequences of our actions... we must play close attention to these shortcomings of rationality. They are the path of analysis for us to understand how it emerged in evolution.

Concerning the 'extended mind', he explained that it is a very strong idea coming in modern times from Andy Clark and David Chalmers and also from 19th century naturalist Baldwin. The Baldwin's effect shows that not only what we do but the very furniture of reality, the set of objects we deal with in a daily basis do have a 'ratio', an intrinsic logic. It is very plausible that a part of our mind has a connection with our world. We can label this an 'extended mind'. Human mind has many structures: perceptive structures, will, imagination, emotions, political bias, religious beliefs and many more. Most of the structures do reflect our own interests, our communities, the history of our societies, our intellectual traditions... But there is an exception, rationality describes not only an inner,

subjective reality but also most enigmatically what is out there, and it seems to match, what is very enigmatic. Not just the subjective things, such as our preferences in taste, which only reflects an inner world, a subjective experience... but a rational statement about reality is not subjective in that sense. We could say it reflects an extended mind, a special part, a block of human mind that connects itself with the outer world.

About the emotions and their intromission in our rational life, in Curado's opinion it's a never-ending story. Emotions seem to be a way to determine the agents' decisions. They see theoretically all possibilities but their feelings are the ones helping them make their decisions. Prof. Curado pondered the possibility that machines may be built in the future which can help determine actions with devices other than emotional devices.

Ivo Chelo (Research for Evolutionary Genetics, Portugal): ***Rationality's shortcomings as proof of its evolutionary origin?***

Ivo Chelo pointed out that rationality's shortcomings seem not to be a good sign of adaptation. But because of the complex adaptation process itself, reason could have evolved through adaptation and then various causes may have caused the shortcomings.

Manuel Curado clarified that rationality's shortcomings are for him rather a precious hint, a proof that rationality has been indeed selected by evolution. Evolution would have selected precisely this structure of human mind, with its complete set of shortcomings. This list of shortcomings is precious for us, for our enquiry to understand the enigma of rationality. In the 18th century rationality was considered a perfect structure, but already at the end of 19th century everybody began to doubt this perfection of rationality, as seen with the problems in Mathematics. A philosophical technique is to imagine possible counterfactual scenarios, where we can imagine beings with a perfect rationality, much better than our own rationality (though in his opinion that kind of beings does not exist anywhere else).

Ignacio Núñez de Castro (Biochemistry and Natural Philosophy, Spain): ***Influence of Augustinus or Averroes' conceptions?***

Ignacio Núñez de Castro commented about Monserrat's assertion that transition from concrete to abstract is rationality's main characteristic. This conception seems proper of Augustinus and his idea of *illumination*, and seems also close to Averroes' conception of *intellectus agens*. Is the concept of emergence an inversion of the scholastic concept of *intellectus agens*?

Javier Monserrat clarified that what he said earlier had no relationship with Augustinus nor the scholastic. He was speaking of the process of evolution, stating that probably reason has emerged evolutionary as a process of automatic system analysis within the concrete situation of living beings. In the course of this evolution, one stage after the other, system strategies would have emerged in animals. This could be explained in terms of the epistemology and logic of Peirce or even Zubiri. This system analysis in animals is very concrete and human reason could be the superior stage of this system analysis. All this was said in relation to the ideas debated during the first two sessions of the seminar. Where it was also discussed that this conception should be completed with the idea that human reason is also the result of a holistic experience.

Ignacio Núñez de Castro pointed out that Augustinus explained the holistic experience by illumination.

JAVIER MONSERRAT replied that today science is thinking these questions in a different framework, so that this holistic experience might perhaps be explained in a completely naturalistic way. In fact, the holistic experience of the world makes it easier to admit the possibility of the existence of God, but it can never be a proof of God's existence. We can accept all this quantum coherence, superposition, etc. and give a new holistic vision of the world, trying to attain a naturalistic explanation of it.

JAVIER LEACH: ***Different levels of the holistic experience*****.**

JAVIER LEACH explained that there are different levels for the holistic experience. The entanglement (presented by Walach in our second session) is a very complete experience that cannot be explained mathematically, so that two complementary theories are needed in order to explain it. It needs to be objectified with two different mathematical theories (like waves and particles). But in his opinion there is a different level of holistic experience, the metaphysical experience. When you experience reality as a totality, the question is why something does at all exist; that is the metaphysical question.

MANUEL CURADO admitted that this was a very profound issue, and it was hard to add anything to it. He just wanted to share that a few years ago he tried to analyze a beautiful text that described those kinds of experiences from a naturalistic point of view, written in is our common natural language, for instance the eschatological myth of Plato, which describes holistic experiences of death, the afterlife or the very essence of the universe. In this analysis he found out some logical principles that seemed to be a violation of the usual ones, but also seemed to be somehow the same.

SEAN WINKLER (Loyola Marymount University, United States): ***Exploring the possibility to obey or disobey natural structures*****.**

SEAN WINKLER commented his interest in the subject of there being different structures in nature and the possibility to obey or disobey them. We can assume that some contradictions in logic might be possible (as the African people who have the ability to sustain contradictory thoughts at the same time), but we also understand that some structures in nature do need consistency in order to stand the test of time. He asked for some possible counterfactual scenario where these possibilities could be explored.

MANUEL CURADO stated that to think a scenario where physical laws are violated can only be done in an imaginative exercise.

CHRISTINE HELLER (Electrical Engineer, U.P. Comillas, Madrid): ***Where does our need for consistency come from?***

CHRISTINE HELLER commented about our strong need to defend logical consistence, mainly because of the training we have received. She remembered how in our seminar's last session a young female engineer stated vigorously during the debate that inconsistencies are not possible, and wanted to bring into consideration if this need comes from our type of rationality, our models, our language or perhaps our emotions. And talking about emotions, she also wanted to mention the case of robots that are being made to interact apparently in an emotional way and the kind of reality that is implied in this task and that is so hard to grasp in our scientific models.

MANUEL CURADO pointed out that many variations of rationality may materialize in different structures (as for instance, language, with the example of the Zande ability to

sustain different opinions about the same topic at the same time), but for the basic structure of our rationality it is impossible to be otherwise. He finds it impossible to imagine a human being (toddler, young person or an adult full of wisdom) trying to make the right choices without the basic structure of rationality. We can take into account all kinds of minor variations, as different feelings, opinions, religious beliefs, political parties, but there is something in common that we can't even imagine to be able to leave out: the very essence of rationality, the obedience to logical principles, the respect for the overall coherence of reality. The human rational structure has handicaps and intrinsic problems.... but notwithstanding this, it survived in a very demanding context, and this context is evolution.

After this last question was answered, Javier Monserrat thanked everybody for their attendance and participation and ended the session, but not before mentioning that a summary of each session of the seminar is being prepared and the way to get them for any interested person.

IV. JAVIER MONSERRAT'S CONTRIBUTION TO CURADO PRESENTATION

Professor Manuel Curado's presentation at the meeting of Sophia-Iberia's Academic Seminar in Braga is extremely suggestive. I understand that, ultimately, he provides an evolutionary hypothesis that could explain the genesis of reason. We are in agreement with this general hypothesis. But if we want to go deeper (to reconstruct in detail the sequence of neurological, biological and physical states of the evolutionary process leading to the emergence of reason), obviously, we must risk more precise conjectures. We will try to comment the ideas presented by Curado; comments that are likely to be extended in order to consider their consequences in the overall logic of the Seminar.

Curado begins affirming that rationality has emerged in an evolutionary world. This fact appears to be a contradiction 1) because evolution is always a causal, probabilistic and statistic process, 2) even though rationality seems to have a claim of absolute security in providing statements about objects and processes in the world. We would say that evolution is insecure and open, but rationality is secure, closed on knowledge of absolute truth. This contrast is pointed out by Curado in a rhetoric manner, since, during the presentation, he explains why this contradiction does not really exist: because reason is not absolute, but an evolutionary open process. Therefore reason must be understood in the context of evolution. The contradiction raised by Curado in the beginning of his presentation is only rhetorical because rationality at the end will not be understood as it was initially presented. Reason is, in fact, a product of evolution: it is a fact that occurred in evolution and it is subject to natural constraints and frailties of the evolutionary process. If this is really the thesis of Curado (and we think so), we do agree with it.

Therefore, in order to review and comment the thesis of Curado it is desirable in our view to start at the end of his presentation. It is explaining Minsky's thought

where he assumes his evolutionary approach to understanding the emergence of reason.

1. Minsky and the evolutionary nature of reason

Curado said that Minsky places rationality in the right context, the evolutionary nature. Minsky's question about the possibility of intercommunication with aliens is, in essence, a question about human rationality. Minsky argues that this communication would be based on the fact that the possible variations of rationality in the universe are very limited. Human beings, biological beings and possible extraterrestrial beings would be limited by the same «computacional constraints». Curado means that this position brings together two arguments of great philosophical importance: theory of evolution and computational constructions. Every being, living or non living, can be understood (according to Minsky) as «a general problem solver» that has to adapt to the same natural constraints: Hence ways should be devised to represent these situations and processes and at the same time to manipulate these representations. Curado, so far, according to Minsky, introduces an important expression (also used throughout his presentation): «Computational constraints» attributed to the world (the world is the agent that enforces these computational constraints). This would deserve a first comment.

Computational constraints. In scientific language a computer is an engineering tool built by humans to process information, according to certain rules of operation. These computers can respond today to a serial or connectionist engineering PDP (parallel distributing processing). Minsky rejected, since his criticism of the first *perceptron* designed by Frank Rosenblatt, the connectionist engineering feasibility. Therefore the universal Turing machine is then the basis of serial computers that respond to Minsky's thought. Accordingly, a serial computer is an instrument that records information to process it by implemented algorithmic programs. These consist of a serial sequence of operations processed in one CPU, when applied to a previous database. It is thus very difficult to argue that the universe as a whole might be a serial computer. But what science really tells us is only this: that the ontology of matter produces evolutionary processes that are manifested in laws and physical structures of the real world. Physical events in the universe are not «serial computations», but real «interactions within matter according to its own laws». These laws produce by themselves a sequence of interactions, similar to an algorithm, but are not themselves a designed algorithm (at least science cannot think so). Therefore, given the deterministic character (at least in part) of material interactions in the history of the universe, it is possible to computationally simulate the genesis of the universe and its processes. The universe, therefore, can be simulated, more o less with an approximate accuracy, on a computer (for the scientist who knows the laws of natural processes), but the universe is not itself a computer. In our view, it seems not to be wise to use Minsky's expression speaking of «computational constraints» either of evolution or of reason. We should better speak of «natural constraints».

Notwithstanding, scientists who know these «natural constraints» can design serial computing programs which will be subjected to these «natural constraints», to design their algorithmic processing sequences.

Deterministic natural constraints and genesis of reason. Since the *big bang* occurred, the macroscopic universe responds to a deterministic system (at least in part). It would be the deterministic universe that was dreamt up by Einstein, still in the conceptual paradigm of classical mechanics. According to the above discussion, a serial computer (built by the human mind) would be more or less accurate in their simulation of a universe with «natural deterministic constraints». But it is not just the case that scientists could translate the «natural deterministic constraints» in «computational constraints». It is something more important. The human mind (reason) has evolutionarily designed its operation rules to represent a universe which is made objectively by these «natural deterministic constraints». These rules – logical and cognitive – have shaped in part the human mind. Classical mechanics has described the macroscopic deterministic world, which we have referred to in previous sessions of the seminar. Life is a system and anticipates the future through systems analysis and synthesis (Poli, First Session).

Curado notes that reason stems from the objective structures of the world. «The very core of this argument is the notion that the emergence of rational structures was inevitable. 'To evolve' means in this context to search inside a universe of possible structures». And further: «Precisely reason seems to have a structure amazingly homologous to the computational structure of our world, it's possible that human reason has an interest of its own». Alluding to the title of Curado's presentation, we understand that there is a real «Interest of Reason in the World in Evolution». Reason is, so we think, a life instrument of adaptation to the constraints of a real objective world. Reason is evolutionarily designed (at least in part) to represent an objective world of deterministic systems and structures (a mechano-classical world). This is a natural survival interest in an evolving world.

However, in our view, limiting our experience of the world to these «deterministic natural constraints» (which Curado, according to Minsky, call computational constraints) and limiting our representation of that world to deterministic systems and structures (believing the world is well simulated by computer models) would be a «constraint» in our mind that would be inconsistent with the objective evidence of living beings. This «constraint» has been called «reductionism» in the history of thought. Thus, reductionism has tried to «reduce» the explanation of all reality to the deterministic classical mechanics. This has led to great dissatisfaction among many scientists and philosophers because the world, though really deterministic in part, is not an «absolute deterministic prison» where living things (and people) are enclosed (absolutely determinated).

2. Beyond Minsky's «computational constraints»

It seems inevitable to accept that the configuration of reason has an evolutionary origin and therefore it is *a posteriori*. The only «constraint» should

be the natural ontology of matter generated through the very primordial event of the universe in the *big bang*. Matter that has produced through time, as a consequence of its own ontology, the states and the current organization of the universe that science describes. Therefore the point of science is that the ontology of matter has not only been able to produce blind interaction between mechanical and deterministic systems (and the appearance of blind robotic systems, pure cybernetics, with mechanical self-control and anticipation of the future). It was also able to produce the emergence of sensation, perception, consciousness and what we call a «psychic subject» in both the animal and human beings. Through natural Mind – that of Minsky, or of any other human being – a «psychic subject» (human) leads representative processes of the world which respond to the «interests of life».

We think, therefore, that the mind is evolutionarily shaped to form representations of the objective world. It has therefore been shaped by its experience of the «objective world» which always represents the fundamental constraint. But the important thing is to realize that the mind has not only had experience of a world made of «deterministic natural constraints» (or «computational constraints», according to Minsky), but also experience of a world of sensations, perceptions and consciousness. The world in which the «psychic subject» – which possesses a «mind» and produces representations of the world applied to optimal adaptation – is done in part by a mechano-classic stable and deterministic system (the biological body), but also partly by a system of indeterministic decisions and holistic sensations. Therefore, if reason is an instrument of adaptation to a real world experience, it is conceivable that reason's shape (its functional logic and cognitive processes) will depend partly on the experience of a (mechano-classic) world of difference, discontinuity and determination. But it also will in part depend on the experience of a world of continuity, indetermination and holistic fields (see Second Session: Walach).

The challenges of the pure «computational constrains» of Minsky's reductionism has been observed by Curado in his presentation when he says:

> «There are, of course, a few problems with this Minsky's argument. The first one is, obviously, the conviction that the human brain is a universal Turing machine. Nobody is sure about this point, and it's possible that the most interesting rational processes, like creativity in general and mathematical creativity in particular, cannot be described according to the notion of Turing machine. Another difficult point concerns the supposition that all parts of reality organize themselves with computational processes. For instance, nobody is sure about this point in what concerns the microphysical realms. (For the sake of the argument, we can emphasize that biological evolution happens on complexity levels very different from the complexity level of microphysics)».

I think the problems mentioned by Curado, in reference to Minsky's «computational constraints», have already been addressed during the Seminar in the discussions of Roberto Poli, Gregor Nickel and Harald Walach. A) The genesis of reason depends on the prior existence of a universe of structures and systems (generated since the *big bang*). So life has probably been produced by

evolution as a cybernetic system that interacts with the environment by physical-chemical-biological mechanisms. A system that, according to Poli, might even be able to cybernetically anticipate the future. B) But the genesis of human reason (and also of animal knowledge) depends on an emergent property of the ontology of matter: the sensitivity that by its evolutionary complexity ends in the perception lead by a «psychic subject» with an integrated consciousness. C) Therefore, living beings have «sensed» (perceived and made conscious) a real-world of structures and systems where everything is rigorously deterministic. As a result, this sensation modality has led to some representative functions (logical and cognitive) as an analysis of structures and systems that respond to a mechano-classical objectivity (they have «represented» the world as a system of elements and relations). This was addressed in the first session of the seminar. D) However, the capacity to «sense» (perceive, to be conscious) presents not only a real world of structures and systems (stable objects, discontinuous and differentiated into a network of structures/systems), but also a world of no less real indetermination, unitary fields and holistic sensation. E) It is then conceivable that reason will also be configured to produce adequate representations of that indeterministic and holistic world to get an optimal adaptation to it. Hence the sense of Walach's proposal calling for a psychology based on a «principle of complementarity», in the same way as modern physics has also established a «principle of complementarity».

3. Curado's conjecture

Curado concluded his presentation with a conjecture: «I'll end this talk with a very imaginative conjecture. Let me state clearly that I've no way of proving it. If you want so, feel free to interpret it as a literary or philosophical suggestion». We also consider interesting to provide our commentary on these assumptions, trying to be consistent with what we have previously stated.

Computational structure of reality? The first conjecture is made by Curado this way: «Human rationality has a structure homologous to the computational structure of reality; we can verify this with a few concepts derived from Physics or from the Sciences of Complexity (namely, algorithmic compression, locality, logical depth, and Turing machine), or with the biological concept of Darwinian evolution». But I say, not only that. The right assumption must be that human rationality is derived not only from adapting to a mechano-classical deterministic world (although in part it is, and thus it is suitable to represent and simulate a deterministic world). Our reason is produced also from adaptation to an indeterministic world and to holistic experiences, as they are felt and perceived by living beings (hence the human creativity, imagination, philosophy, art, poetry, literature… and the ability to devise a quantum-mechanical physics). Human rationality reflects not only the stable determination of the world (our biological body), but the holistic indeterminacy is also reflected in one physical dimension of the world, not less empirical than the other (our psychic experience.) Therefore

we do not know: a) whether the classical mechanical world as a totality can be simulated by computation (in part it can), b) whether the world of holistic indeterminacy, the world of uncertainty which is reflected in the human mind can be completely simulated by computers (in part it can).

Weakness of the products of reason. Curado's conjecture: «Human rationality seems to be an unfinished building, because it offers us both true statements about reality and a cohort of paradoxes and constitutive problems». The conjectural character of human knowledge, and of science, is a basic principle of modern epistemology, at least since Popper's critical rationalism. It is, let's say, the basic conjecture of epistemology.

Evolutionary emergence of reason. Curado's third conjecture responds to the evolutionary origin of reason in order to adapt to the real physical universe. «We know that rationality emerged in a precise evolutionary sequence we call 'our universe', and, as far as we can see, it's part of the whole observable universe because this universe can be explained using rational natural laws». We completely agree. Reason is possible because the universe has been objectively made according to natural rational Laws that, as we explained earlier, are produced by the ontology of matter emerged in the Big Bang. Notwithstanding, we can't argue scientifically that this kind of ontology should be necessarily the case.

Multiverse? Curado's fourth conjecture is certainly the stronger one. In reality, it is an unnecessary conjecture to explain the origin and nature of rationality in our universe. Curado seems to be attracted by the hypothesis of multiverses, according to the version offered by Max Tegmark. «Taking notice of the physical theories of the Swedish physicist Max Tegmark and other Many Worlds Interpretations of Quantum Mechanics, it may happen that our world is not part of a universe but part of a multiverse where all conceivable possibilities are indeed existing». «Many other types of rationality could exist in many other universes of Tegmark's multiverse». Tegmark's theory is known as the «*ultimate ensemble theory of everything*», whose only postulate is that «all structures that exist mathematically exist also physically». A theory of this nature cannot be proven nor disproved. It cannot undergo any arguments that could show that it is false. Therefore it is doubtfully scientific. It is pure speculation with no scientific evidence. This is the case for other autor's theories of multiverses and for the string theory itself, now under severe criticism (Lee Smolin). Are there any alternative rationalities? We think so, but not because there are multiverses, but because the rationality which so far has described our objective physical world could be incorrect or in need of new formal and scientific formulations.

4. The characteristics of rationality in our universe

Therefore, reason understood in this way (as a form of representation constructed at an early stage in the animal mind, and finally, in the human mind, in order to perfectly adapt animals and men to the objective physical world so that they could survive) has an evolutionary origin that explains its nature. It

functions as a structural analysis of objective world in classical mechanics, but also as representing an objective world of holistic indetermination. The four initial features, explained by Curado in his presentation to understand the evolving nature of reason, respond to this approach. We fully agree with them, provided they are understood in accordance with the observations we have stated. Curado tells us of three properties of individual reason (creativity, locality and logical depth) and of a fourth property we could call «intersubjective complexity».

Selective and biased rationality. For Curado it is clear that rationality is not a reflection of the objective world (as intended by the positivistic «objectivism» in the «mirror theory» of the early Wittgenstein). Popperian rationality has a creative sense, as the passive reflection of the world is impossible. «The special beings that do own those structures – ourselves – do not duplicate the world. Rationality is not a perfect mirror of nature. It's selective, biased and, obviously, is much more simple than the whole of nature itself». Never comes to exhaust the depth of nature presented to us through the experience of phenomena. This epistemological point of view is a consequence of evolutionary theory of knowledge. Humans are not in possession of the truth, but must build it rationally through *a posteriori* critic, analysis and synthesis, of phenomena, being always open to rebuild these constructs. The logic of Popperian rationality is always evolutive.

Locality. The evolutionary configuration of the animal and human mind has always relied on their adaptation to an objective, immediate, local environment. In this regard, as Curado rightly notes, rationality is always local. It could not be otherwise, at least in its origin. «Saying this otherwise: human mind has the obvious property of locality. In order for us to know something, we don't need to know everything in the universe. The way we know something is always local and regional; one could also say, atomic». However, that rationality might be local in origin, does not prejudice that it must be local in its final stages. The laws of physics, for example, based on local analysis and synthesis, are a generalization for the whole universe. This generalizing capability based on the rational formalization has also an evolutionary origin (see the discussions of the Second Session). However, it is a hypothetical generalization, critical and open to constant reformulation in the history of knowledge.

Logical depth. In an evolutionary perspective, the premise to understand how reason has been formed and how rationality has become more and more complex, i.e. what its origin and its nature are, is the content of the objective world. As Curado says: the logic depth of nature is driving the growing logical depth of human rationality. «Let's state this without ambiguity: the structure of human rationality is connected with the degree of complexity of the world itself. Using a category that belongs to physics and the complexity sciences, one would say that our world has depth, logical depth, I mean, the world had to take many steps to go from the beginning until the level of organization we see around us. If we consider the world as a computational system, this current level of organization would imply time, huge amounts of time, many steps in the between and the progressive abandon of simpler levels». However, what dimensions leaves

open the logical depth of the world? Curado seems to point out again the computational depth: «How can we explain the emergence of rationality in a world in evolution? What must we precisely explain? These aspects seem to me the most relevant: algorithmic compression, locality of our knowledge and the degree of logical depth. Is this enough?» However we insist on our point of view: it is not only an understanding that could express algorithmic aspects of the deterministic and mechano-classical world (the serial algorithmic programs can simulate in part the processes of nature), but it is also an understanding of our indeterministic and holistic experience that cannot be done algorithmically.

Intersubjective rationality. Curado says that these three characteristics could exist even if evolution has allowed for the existence of a unique rational being in some places in the universe. «Let's add, then, a fourth property to the already mentioned three. I'll name it as the multiplicity of rational beings. When we mentioned algorithmic compression, locality and logical depth we were very close to an anthropic perspective, I mean the universe has unfolded itself in such a way that it allowed the emergence of rational observers. On the contrary, the multiplicity of rational beings shows us imperfection, impotence and incompletitude. Rationality is not only the most beautiful collection of mankind's highest achievements; it's also the problematic collection of permanent underachievements and very humiliating ones». Every human being can build their rationality from a certain locality. Therefore subjective rationality must be confronted with the subjectivity of others, becoming intersubjective in society. Science and rationality are an intersubjective social process. This difficult process is commented by Curado in the framework of the so called «The button dilemma». Intersubjectivity is also compatible with the final evolutionary perspective that we and Curado defend.

5. Conclusion: the nature of reason as an evolutionary interest

What is the origin and nature of reason? Curado's answer has been elaborated from an evolutionary framework: Reason has occurred in the evolution and it is its evolutionary origin that explains its functional characteristics. Reason reflects the nature of a living being who must survive by adapting to the objective environment. Reason is an instrument for survival in living organisms by producing representations that install them in the real world. The title of Curado's presentation reflects his fundamental evolutionary approach: the Interest of Reason in a World of Evolution. The interest of reason is adaptive and occurs as a result of an evolutionary adaptation process of living things with sensitivity-consciousness to an objective reality.

However, we believe that adaptation involves not only adapting to a mechano-classical world that gives rise to a deterministic world that may be reflected in computational constraints constructed by human mind. The living being not only feels a mechano-classical world (where certain levels of computable determination are real), but also feels an holistic indeterministic world (actually unified physical

fields) to which it must also be adapted. Therefore, reason probably reflects not only how to represent a world of deterministic structures and systems (Poli, First Session), but also how to represent an indeterministic and holistic world (Walach, Second Session). Reason has a long tradition of creating a deterministic science (mechano-classical). But it's only beginning to build a scientific representation of a no less real indeterministic and holistic world, which has always been expressed in ordinary knowledge, poetry or art. The evolution of reason through the epistemological characteristics studied by Curado (selective and biased rationality, locality, logical depht, intersubjective rationality), not only should be applied to the representation of «computational constraints of the world» (Minsky), but to a reason that constructs representations to adapt to an indeterministic and holistic world of actual experience of living beings (Walach).

V. PRELIMINARY CONCLUSIONS OF SESSION III

Projecting the ideas presented by Curado in this session on the logical thread of the Seminar some basic statements become highlighted. The logical thread responds to a fundamental orientation: what is the origin and nature of reason? The course of the Seminar allows us to establish a set of clues to answer this question.

1) The fundamental reference point to explain where reason comes from is the existence of an objective world, built in a certain way. Living beings must adapt to it according to the way they «feel» it through the sensory system. Therefore reason is an evolutionary adaptation tool that is configured to «represent» the objective world and perform an action-oriented best adaptive knowledge.
2) Reason finds by experience a deterministic world (classical mechanics) built in the form of systems and structures (Poli) which are a set of «computational constraints» (Curado). This results in a certain way of knowing the world that has been expressed in formal systems of classical mathematics and in the traditional image of the physical world.
3) However, Walach's contribution leaves the door open to understand that reason has also been produced by the experience of an indetermistic and holistic world. This type of reasoning is shown in ordinary knowledge, poetry and art, for example. But it is clear that science has not yet found the way to describe this strange world. Quantum mechanics, as discussed in the Second Session, would be the scientific framework that so far has described the microphysical indeterministic and holistic world. Curado does not develop this quantum world open by Walach but he is not closed to the admission of its possible importance, as explained above.
4) Formal systems are a fact that has been noted by Curado. But we do not know why mathematics coincides with the real physical world. We are

> open to the possibility that our reason could build alternatives to the formal systems that exist today. Science has built formal systems to describe the classical world that have been proved highly effective. But science could imagine new formalization systems to describe the quantum mechanical world. All this is open. Curado, in accordance to his evolutionary approach, insists on the freedom of reason in the imagination of its formal worlds, as Gregor Nickel has also pointed out from his own point of view.

In conclusion, reason has been configured in the evolutionary process as a means of survival in an objective world. A deterministic objective world of systems and structures has imposed settings of a certain aspect of reason. But an indeterministic and holistic world has also left its mark on the ordinary human reason and has produced in science the quantum mechanical image of the world. In its representation of the world, and its formal systems used to describe it, natural reason is weak, full of shortcomings that can be explained precisely because reason is built step by step through evolutionary adaptation. Therefore the evolutionary origin explains the nature of reason.