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Interdisciplinarity as a Tool to the Understanding of Global Behavior Under Uncertainty in Science and Society

Petre Roman

Department of International Relations, Swiss Umef University, Geneva, Switzerland

Email address:
proman@clubmadrid.org

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Abstract: Between the zone of certainty beyond all doubt and the zone of incomprehensible uncertainty, the sources of which are nothing but chance, we need to use solid results from a vast interdisciplinarity. We wish to give here a sense of the factors in play and the state of the debate and advance in the territory of how interdisciplinarity may help to solve problems which are common in many areas of knowledge. Chaos and complexity certainly put limits on what we can know. High complexity, asymmetry and/or non-linearity are universal types of imprecision. Can hazard have purpose and direction?The idea is that the more effort we put into project design to cover as many details and possible consequences as possible we can grasp in our in-depth analysis aiming to create the project (in art or science or society), the greater the chances that the random occurrence of the unpredictable event will settle on the project's purpose and direction and not on contrary to them. There is no vicious circle here. This kind of method can explain many good results already obtained in such circumstances. Simplicity, beauty, rationalistic optimism, are features of unshakeable scientific results We may call this feature of scientific theory or art *uniqueness.* Uniqueness is strongly correlated with *essentialization.* Science is working in that sense: to simplify a phenomenon to its essence in order to study it easily without losing anything important in the analysis. That is *essentialization.* Why and how complex systems move to the edge of chaos? And what do they do to stay there? They are in constant struggle to create or keep order in complexity. That is the pattern of self-organization, the specific feature of human nature. That is why our action is meant to build resilience to deal better with unpredictable events and prevent the emergence of a critical threshold. Uncertainty, indeterminacy, randomness, and contradictions appear, not as non-essential substances of debate to be eliminated by explanation, but as everlasting ingredients of our conception of reality. There are compelling reasons to believe that it is impossible to make accurate, nontrivial predictions concerning human behavior. Logic and reason are and remain priority, but unpredictability forces us to imagination and creative thinking. Indeed we are confronted with a new human landscape. The anomalies become the new normal.

Keywords: Interdisciplinarity, Unpredictability, Chance, Uniqueness, Essentialization, Global Behavior

1. Introduction

In a previous article Roman concluded that: “between the zone of certainty beyond all doubt and the zone of incomprehensible uncertainty, the sources of which are nothing but chance, we need to use solid results from a vast interdisciplinarity” [1]. Searching for an integrative core, to order and make sense of the mass of new as well as old material, from science, art and human activity, daily arriving on the global market and all considered to be true, is the goal of interdisciplinarity. The intention here is not to propose an approach to a philosophical problem. The starting point could be what we mean by interdisciplinarity, but it is beyond my capacity. Rather, it is to give a sense of the factors in play and the state of the debate and advance in the territory of how interdisciplinarity may help to solve problems which are common in many areas of knowledge. The formation of fundamental ideas is in itself a matter of the huge diversity of human perspectives: truth, information, evidence, experience, experiment, probability and many others. Interdisciplinarity is there to produce interpretations of everything needed in the society. “Scientists usually develop many speculative and unarticulated theories” says Thomas Kuhn [2]. Nevertheless, they do find the way to new solid results. But in many cases

they need more coherence which could come from interdisciplinarity. Above all interdisciplinarity is ample and passionate documentary research providing a large rise in quality knowledge based on an acceptable amount of work to wield knowledge. And it is so vast not only because it has to encompass so many fields but also to take into account the numerous randomly interconnected simultaneities. In this last case it is an uncharted landscape of many possibilities.

Commitment to critical interpretation - as opposed to fact-finding or appreciation - and to enhanced and efficient cooperation is the primary tool for interdisciplinarity. It can also be a strategy that aims at more objective knowledge, yet not necessarily providing one more coherent point of view. But certainly a powerful space of intersection and fine-tuning made of different traditions of thought. And making you concerned with some specific details - those preventing you from disregarding what is important. Thus, some unanswered philosophical questions (or even scientific riddles) become more answerable. There are still many artificial and outdated boundaries between various branches of science and even much more between science and philosophy or art. Indeed, such boundaries are obstacles when we are facing the assault of irregularity, of disorder, of complexity which has a long history. In our times we have experienced an exceptional intensification of them, as they are essentially opposed to theory, hypothesis, generalisation. Chaos and complexity certainly put limits on what we can know. High complexity, asymmetry and/or non-linearity are themselves universal types of imprecision. The things we want to study are sometimes composed of many objects that mutually affect each other. Therefore, we are impacted by the interference of various types of imprecision. They accumulate and give rise to a process of escalating imprecision, with effects that are difficult to predict. They can appear in any kind of systems: physical, biological and social, the formal and axiological logical-mathematical, and in mathematics itself. The variety of words that express it is vast: unpredictability, risk, uncertainty, randomness, possible, vague, fractal, then: incompleteness and undecidability, ambiguity, paradox, antinomy as well as entropy and variability. But also doubt, confusion, ignorance or hesitation. Finally, the believable, the credible, the plausible. The semantic aspect provides to the greatest extent coherence in the system. Uncertainty, indeterminacy, randomness, and contradictions appear, not as non-essential substances of debate to be eliminated by explanation, but as everlasting ingredients of our conception of reality. Literary prowess seems to me sometimes more capable than philosophers to express (not necessarily to grasp) imprecision. Here, for example, Joseph Conrad: “The most obstinate ghost of man’s creation” is “the ghost of doubt”, “that doubt which is the inseparable part of our knowledge” [3] and Peter Ustinov: “Remember only that mankind is united by its doubts, divided by its convictions” [4]. Under such conditions, for human life, which characteristically involves imponderable choices, betting, effort, and surprise, it seems there are two kinds of worlds: one dominated by “blind... necessity”, as Hegel considered it, and another, dominated by pure chance, both behaving equally irrationally. The first through “excess of rationality” or even “irrationally rational”, would not normally be in any kind of movement. The second would rather be chaotic than order. Anthropologically, “the consequences would be... hallucinatory. In a world of blind necessity, neither freedom nor responsibility, neither truth nor falsehood, neither good nor evil, would be possible.” The other one would be the place where “do whatever you please” becomes an imperative behavior, though a quite weird one [5].

Unpredictability makes the statistical analysis of randomness necessary but does not imply that nothing better is impossible; simply, we are aware that treating it has general inherent limitations on how well it can perform to comprehend the occurence frequency of unpredictable situations. Under a wide hierarchy of systemic complexity “the problem of the ambiguity and the uncertainty between error and truth is brought (today) to its climax”. The fruitful ambiguity, for instance, is when an error becomes valuable information: “You seek – India – You find – America!” as exemplified by Edgar Morin [6].

There are nonlinear unpredictable complex systems developing chaos under very small perturbations and random systems where patterns of order and structure are not detectable. We live in complex systems, we differentiate between chaotic and randomness and we deal with them (see in this article §4, “Global behavior and cultural code in complex systems”) But often we generate accidents harming humanity. Fighting imprecision is fundamentally the task of science. Just opposing resistance to an evident danger is to live under a permanent risk. Thus, action based on science is imperative. Probably on a scale which has to be constantly and significantly enlarged.

Everyone and everything now seems to be pursuing fine-tuned models as ways of providing access to knowledge. But, there is no permanent fact or at least framework of the matter under study about what has happened in other ones when scientists are absorbed into their narrow subject of interest. What does a scientific microstory of microstory (paraphrasing Anthony Grafton’s *microhistory of microhistory* [7]) tell us about the state of the discipline of science as a whole? It is only when intellectual curiosity and real communication between the many sides are actually established that correlations become real. The relational interpretation comes with such correlations. Reality is not identical for all but stability of rational belief makes it almost the same and therefore different systems can interact. Thus, the fixation of structural parts that are constitutive of our perennial way of understanding large branches of knowledge, both the structure of it and the functionality of the various component parts of those branches, is of tremendous importance.

Added to this are the problems of chaos which have given a new stimulus to trend towards interdisciplinarity. Scientists from very diverse fields have seen themselves united in the face of the same dramatic problem of understanding the nature of chaos and understanding chaotic behavior in natural

and social systems. The natural reaction is to transgress disciplinary boundaries. Solomon Marcus, well known for his "Poetica mathematica", explains that "Much of the work today (in social sciences) builds upon existing logical frameworks developed by philosophers and computer scientists incorporating insights and ideas from philosophy (especially epistemology and philosophy of action), game theory, decision theory and social choice theory" [8]. A philosopher is a wise person (Dante calls it *lady of the intellect* - in "The Convivio" - while Nietzsche *a grandee of the intellect* - in "Ecce Homo") who is independent and courageous and morally powerful enough to tell the truth about life in all its complexity just because he or she grasps a sense of responsability in it. "Philosophy founded on pleasure or utility is not true philosophy but philosophy by accident" and "true and perfect philosophy is that which is engendered by worthiness alone" says Dante [9]. Usually scientists see no need to wield the philosopher's tools systematically because the philosophical systems seem inadequate or unproductive for their needs, although many recognize the profound existing interaction between science and philosophy. Nevertheless, "It is, particularly in periods of acknowledged crisis, that scientists have turned to philosophical analysis as a device for unlocking the riddles of their field" stated Thomas Kuhn [2]. The artificial and outdated boundaries that university traditions have introduced between sciences and philosophy are to be removed. The future of epistemology, dealing with all forms of knowledge, since the conditions of truth are not exactly the same for a mathematician, a physicist, a biologist or a sociologist. Jean Piaget, a true promoter of interdisciplinarity, says that epistemology "is undoubtedly to be located in the field of interdisciplinary specialized research much more than that of isolated speculative reflection" [10]. This is in line with Einstein's remarks: "Epistemology without contact with science becomes an empty scheme. Science without epistemology is - insofar as it is thinkable at all - primitive and muddled" [11] and "the scientific method consists in a cooperation of logic and experience" [12]. The density of connections as a result of interdisciplinarity increases the behavior's predictability to be more stable and resilient. So, prioritizing connections and/or connectivity is a constant source of energy for interaction.

Now, one caution (*ephexis,* following the Greek Sceptics) in judging and concluding from facts. It's instability rolling the wheel of luck which is an indispensable ingredient for improving the personal condition of individuals. Rules of restriction and limitation meant to increase stability and predictability may also trigger, under unchecked circumstances, instability. What we can express with (relative) simplicity, as in the process of approximation in mathematics, is certainly less than what we can conceive. The process of approximation is a process of modeling the surrounding world. Our concepts fly freely over this world. But concepts without approximations yield nothing that could stay permanently in the realm of science. It's just that so often we don't make history (or even science) in circumstances of our own choosing, but in circumstances created by accidents. There is no armor against fate because fate is evenhanded, as a fashion reminds us George Orwell [13]. The uninterrupted attempt to unify all knowledge, through the play of the increasingly diverse emergences in new science, has shown that the whole becomes, almost everyday, more than the sum of its parts. As a consequence it is necessary to assemble as many essential thoughts from very different scientific and cultural domains providing that there is a clear framework. It's a goal worth pursuing under an integratory vision. In music, Wagner devoted his life to the creation of a *Gesamtkunstwerk*, the total work that unites music, theater and painting in a single performance. Could we imagine that thinking which transcends scientific disciplines and cultural works could unite them into an ensemble - a kind of spectacle of thinking - for the purpose of enhancing strategic aptitudes (competencies) to resolve problems of knowledge and decision? Something like *Gesamtdenkenwerk*? Nietzsche, who was intimately associated with Wagner, starts "Ecce Homo" with the subtitle *How one becomes what one is*. Indeed, he aspired to *totality* against separation of reason from feelings or will, because "he disciplined himself to a whole he created himself" [14].

"But in this totality" - maybe the *gesamtdenkenwerk* I suggested - "what is the center of connection, between the genetic system, the individual, the cultural system, the society, or in other words what is the epicenter of the total self-organizing system?" [6].

It could be inspired, for example, by Isaiah Berlin's *The Hedgehog and the Fox.* W. H. Auden quotes Berlin's famous thesis: hedgehogs "relate everything to a single central vision," while the foxes "pursue many ends, often unrelated and even contradictory." Dante, Plato, Hegel, Proust, Nietzsche, and Ibsen are hedgehogs, while Herodotus, Aristotle, Molière, Montaigne, Goethe, and Joyce are foxes. [15].

We have to enlarge this already vast picture since there is not (yet) a unification of general relativity and quantum uncertainty, the massive space and the non-locality space. Both should be thought of as frameworks to understand our universe. Carlo Rovelli, from the quantum physicist perspective says that: "The reason the world still unfolds in a cascade of the unexpected is that there is a gulf between what equations can predict in theory and what it is possible to calculate in practice. Some things are practically impossible to know" [16]. The model used to describe the electron behavior (the "Hubbard model") breaks down electron energies into just two contributing factors – their kinetic energy and the energy of their interactions.

To study the real world and the meaning that its members make of it and how they manage to maintain and achieve social order as a negotiated interactional accomplishment I think could be done from extracting or wielding both the energy of movement and the energy of interactions. Do these two factors have any social or historical relevance? The universe is a probabilistic place, at least from the vantage point of an individual living in it, and coming to terms with

unanticipated outcomes is important. The question now is how to continue exploring global behavior and how to work out what it tells us about what can be done now for tomorrow to be more resilient and more predictable. Transdisciplinarity as we see it in every mundane or extraordinary event is the fundamental modality of globalization in culture with its two pillars: globalization of the knowledge process and the communicational, informational and computational globalization. The phenomena studied in the social and behavioral sciences, the complex human behavior, are essentially/inherently unpredictable and indeterminate. They display the traits of complex systems. There are infinitely many paths to every desirable state of the world. Many of them are completely undesirable and unsafe due to negative side effects. There are compelling reasons to believe that it is impossible to make accurate, nontrivial predictions concerning human behavior, but we have the resources and can study effectively off-equilibrium behavior (as we do in physics, for instance). Logic and reason are and remain priority, but unpredictability forces us to imagination and creative thinking. Indeed we are confronted with a new human landscape. The anomalies become the new normal.

2. The Energy of Movement and the Energy of Interactions

My study into interdisciplinarity came to a new understanding when I saw recent works on the electrons (subatomic particles). They are more likely to come together to perform current flows with zero resistance. In superconductivity, the interactions between electrons result in them teaming up into "Cooper pairs". A Cooper pair is an example of a quasiparticle: a collective state of many electrons that acts as if it is a new type of particle because correlated electrons are capable of otherwise impossible feats. We see all kinds of correlated electron behavior by acting as a physical analogue of the most popular model used to describe them: the "Hubbard model" which breaks down electron energies into just two contributing factors – their kinetic energy and the energy of their interactions, as explained by Philip Ball [17]. But the ambivalent quantum nature of a field means that it can't be observed directly: any observation requires a dose of energy that, in effect, forces the field to show its nature and produce a particle. For this reason, the particle as a centerpiece of research and debate seems unavoidable. And particles are what we see with whatsoever instruments of research. In the scenario where "we think of the nucleus as the sun and the electron like a planet in its orbit" electrons should have a quantum internal rotation that we now call *spin*. This can take one of two values, but nothing in between. But, as we move from quantum particle-sized objects to the larger, macroscopic world, the rules of classical physics emerge and the quantum non-locality vanishes according to Chanda Prescod-Weinstein [18]. Do the two factors, which are not specific only to quantum physics, the energy of motion and the energy of interactions, could be transposed to other fields of social or historical relevance for instance? Research in the social sciences is not fundamentally different from research in the physical sciences. Complex interactions also occur in the physical sciences where, for example, "pressure and volume interact to affect the behavior of a gas, but temperature in turn is another interacting factor and so is the initial mass of the gas and its purity" [19].

The energy of movement is the force of life, in the present at least part of that force of humanity which shapes new spaces of information and communication, new horizons of artificial intelligence. By remixing information from across the internet, generative AI models are messing with the fundamental sense of entropy: growth of disorder. Connectivity, both in the sense of disconnection and reconnection, may become a sort of 'soup' of different languages that is experienced differently by different people. It is changing the whole space of interaction. But wouldn't humans wielding AI as tools be the ones that should end up in control? Some AI researchers are neglecting ethical responsibilities and betraying the public trust. Uncertainties accumulate in this field that make me think of what the Aristotle's Greeks used to say: "The best you can hope for is to avoid the worst". The energy of interactions and interconnections is the road of development of humans, sometimes the only one. To study the real world and the meaning that its members make of it and how they manage to maintain and achieve social order as a negotiated interactional accomplishment is possible from extracting or wielding both the energy of movement and the energy of interactions. That is something completely different from pumping more physical energy from depleted resources which obviously is not the real solution of our time. It can lead to dangerous critical thresholds or tipping points which are a feature of complex systems dynamics. [1]. Interactions do not occur in any circumstance, being triggered by necessity or chance, but they are common and often generate the most interest, insofar as different people react in reliably different ways. Under the combined effect of the energies (of movement and interactions) the current topic should be global coordination and even more: cultural evolution. Concerned about the effects of climate change, we must remember that every action in a global system depends for its success on cooperative behavior. Cooperation is not a solution: it is the only solution. The historian's perspective of Anthony Grafton is: "The knowledge that underpins our world of things, by contrast, has been discovered over centuries, through trial and error, two steps forward and one step back. It has been produced and improved by collaboration: the work of talented, largely anonymous groups, generation after generation, rather than identifiable individuals" [20]. Moreover, I believe that the attitude favorable to cooperation is part of our innate prudence in the face of the unforeseen. Prudence creates a reserve of action. For example, there are still dramatic gaps between the reality of unpredictable climate dynamics and people's expectations and confidence. That gap could be even more dangerous if in

the dynamics of climate change we are moving towards a critical threshold or multiple ones. Such moments of crisis arrive too often on uncharted territory pointing to the (sudden) insufficiency of our average behavior and the necessity of an exceptional one. Thomas Kuhn concludes that "the significance of crises is the indication they provide that an occasion for retooling has arrived" [2]. Since we cannot control the moment of occurrence of crisis we risk going beyond the edge of chaos when we stop organizing ourselves as humanity as a whole, but unconsciously "run away" with nature and forget the implacable necessity of global human cooperation. The behavioral strategies should ignore exaggeration and histrionics and focus instead on hypothesis testing and sound science. Finally, if we reach a consensus it is not uncritical. We condition the benefit on the truth, not the truth on the benefit. Indeed, truth, i. e. the order, is the source of the useful. The error, i. e. the disorder, is not. Wisdom is not just knowledge and doership, it is knowledge *for* doership. The two contributing factors of energy play also in history. One example is the largely successful attempt to create a global united state by Alexander the Great, accomplished in thirteen years, from his accession to the throne of Macedonia (336 BC) until his death [21]. Indeed, his conquests are subsumed by his thinking (his preceptor for three years was Aristotle himself) and his ambition to gather all the states then known, the "Ancient World", from the east of Egypt, south of the Danube, and beyond the Caspian Sea, to the ocean, in the deep south of India, under a unified state form (China was not known at that time). We could place the two factors like this:

- The energy of movement, instilled by Alexander in his soldiers by the swiftness, courage, ingenuity, determination, and military art of his actions;
- The energy of the interactions, based on the diplomacy carried out by Alexander, that is, the permanent offer to the cities and states conquered by his armies to be self-determined provided they accept and respect the condition of their inclusion as an autonomous unit within a new type of state. The mutual relations between the victors and the vanquished meant a turning point the world had never known before. Plutarch places Alexander among the philosophers [22]. Using both energies, Alexander has shown in the history of humanity what I would call *contemptuous fairness*. In his case it was certainly not a weakness as he changed the Ancient World into a more advanced, comprehensive one. And even in our world his example is repeated.

Today one might think that the omnipresence of social media and the widespread addiction to electronic devices, increasing enormously the energy of interaction, would lead to more cohesion of humanity. In fact the opposite has happened, despite the cybersphere's pernicious stranglehold on the collective imagination. Social media is, in many ways, becoming less social but also imperative, as it is today a habit. As a result we can think that *what hasn't been said does not exist* would be a fashion statement inspiring the framework of human interaction. "Most people think with Aristotle that that may be said to exist which many believe", said Arthur Schopenhauer [23] or "Some things will go into words, some won't" in George Orwell's words [13]. I was surprised again to see the similarity with quantum nature. "Each object is defined by the way it interacts with something else. So when it's not interacting, it's just not existing" says Carlo Rovelli [16]. Indeed, in the quantum realm every fact is a relative fact. Philosophical thinking, constantly dealing with objects, was suddenly shocked by the quantum particle's uncertainty and the obvious necessity to include it in a coherent system. Quantum objects and behavior are today facts from experience which I think, following Hilbert, "can neither be reduced to anything else nor require reduction. This is the basic philosophical position that I consider requisite for mathematics and, in general, for all scientific thinking, understanding, and communication" [24]. Though limited, now and here, the things are infinite because becoming.

3. Details and Consequences of a Project Design and the Circular Argument

Ian Hacking's game-changing contributions to the philosophies of science started brilliantly with "The Taming of Chance" which strongly encouraged my thinking: "Chance was no longer the essence of lawlessness, but at the core of all laws of nature and all rational inductive inference" [25]. Chance is somehow legitimated because it brings order out of chaos, increasing the expected level of control. Control not by getting rid of chance fluctuations, but by adding some more! [25]. Chance is tamed, stabilized into a kind of law. Under this idea the question could be: can hazard have purpose and direction? By definition it's non-sense or at best a paradox. But the question may offer some consistent path to results. The idea is that the more effort we put into project design to cover as many details and possible consequences as possible we can grasp in our in-depth analysis aiming to create the project (in art or science or society), the greater the chances that the random occurrence of the unpredictable event will settle on the project's purpose and direction and not on contrary to them. There is no vicious circle here. This kind of method can explain many good results already obtained in such circumstances. We need to understand the overall picture and how it works. And we pay attention to what we failed to do during the simulation based on theoretical modeling. There is perhaps a status of circular argument (the status of the circular argument as persuasion). For instance, induction is a useful habit, and to analyze it, determine its utility, and find on what characteristics of nature it depends, we certainly use induction itself. "In this circle lies nothing vicious. It is only through memory that we can determine the degree of accuracy of memory; for if we make experiments to determine this effect, they will be useless unless we remember them", as Frank Ramsey pointed out [26]. On the larger and generalisable axiomatic system existing since its famous work, Gödel indicated that incompleteness (undecidability) does not imply circularity: "We are therefore confronted with a proposition which

asserts its own unprovability…. In spite of appearances, there is nothing circular about such a proposition, since it begins by asserting the unprovability of a wholly determinate formula…. and only subsequently (and in some way by accident) does it emerge that this formula is precisely that by which the proposition was itself expressed" [27]. What we reasonably hope in the above mechanism of defence against unpredictable events, is that it leads to less ambiguity. In fact, it is building resilience of and in the complex systems. Breaking the circularity seems in line with objective knowledge. Yet, " preserving circularity is, on the contrary, to respect the objective conditions of human knowledge, which always, somewhere, includes logical paradox and uncertainty" says Edgar Morin [28]. Alternatively we could say that in order to not succumb to as a totality (I don't refer here to the philosophical principle cherished by Nietzsche), we adopt a method to explore piece by piece as much as possible. For instance, we may consider that the totality is the behavior in a state of condensation. As a result, efforts of thoroughful concrete creation are certainly better than a one-off anomaly, even a spectacular one. However, it can be prohibitively expensive in terms of time and money. Indeed, the more detail you consider, the more there is to be checked. Nevertheless, our decision must include both the norms (rules) and the chance. In this process, it is not about judging lies from the truth; it is about adopting a truth from multiple truths.

My experience with climbing the mountains made me recently confronted with such a decision. At some point of my climbing on packed iced snow it became impossible to follow my way up. I sliped down more than I could go up. As continuing on snow has become impossible I decided not to give up and, alternatively, climb an almost vertical rock about 40 feet high, non-covered with ice or snow, located near the slope. "I compelled myself to seek with all my strength for a remedy" - taking over Spinoza's advice - "however uncertain it might be" [29], to look and to evaluate every physical ledge offered by the rock which might help me to climb to the top. I rememberd the Jean Paul Sartre's observation about the *coefficient of adversity of things*: "Like the rock that puts up a deep resistance if I want to move it, or on the contrary, it is a precious help if I want to climb it to contemplate the landscape... It is neutral, that is, it waits to be illuminated by a purpose in order to manifest itself as an adversary or a help" [30]. Arriving on top I knew what illumination is in such a case. If we possess only fragments of the whole body of knowledge, the amount of uncertainties could be insurmountable. There is (empirically) a correlation between the degree of existing material evidence and the level of uncertainty concerning what actually it was in the past or it is in the present. The members of a scientific community in a certain field share a paradigm, and, in the meantime the paradigm, by sharing it, is what a scientific community has in common. This circularity, in this particular case, is weird if not vicious. But what if we try to extend the reasoning, through interdisciplinarity for example, to the scientific community as a whole? In other words a paradigm, a "shared example of successful practice", is commonly universal and interdisciplinarity using it does not change that. Saying that the causal connection, "which play a dominating rôle in our thinking", has direction is a paradox as shown by Gödel and reasserted by Einstein in the sense that it "cannot be deduced by means of logical process" ([11], p. 193, p. 200).

4. Uniqueness and Essentialization

Einstein thought that it is possible to develop a "perfect system of physical laws of great simplicity and beauty that will allow a mathematical deduction of all phenomena". Such a system should be the expression of "the belief in the rationality of nature" ([11], p. 157). Kurt Gödel, a close friend of Einstein, goes on to elaborate the reasons for this belief: "... the fact that those parts of mathematics which have been systematically and completely developed show an amazing degree of beauty and perfection. In these fields, by entirely unexpected laws and procedures, means are provided not only for solving all relevant problems, but also for solving them in a most beautiful and perfectly feasible manner" [31]. These facts seem to justify what may be called *rationalistic optimism*. Simplicity, beauty, rationalistic optimism, are features of unshakeable scientific results, which are evident in Einstein's relativity, Heisenberg's uncertainty, Gödel's incompleteness, Copernicus' revolution, Darwin's natural selection, for instance. But why not also in Da Vinci's universal language, Shakespeare's grasp of human condition, Beethoven's heroic and unwavering beauty of musical language, Brâncuși's art perfection in simplicity? We may call this feature of scientific theory or art *uniqueness*. Although such foundational results are solutions of the system, they challenge it. They are radical transformations of the vision about the system. Somehow disconnected from the system, nonetheless solutions to it. In a sense they are "genetic" modifications. From then on the "pattern of the world" is different, possibly totally new. Nothing stays as before. They represent an imparable relativization and they are engines of creativity. And also all of them are not just new symmetries of the scientifical system. Symmetry is normally defined as a guiding line for those seeking universal laws of nature. It is the property of being able to transform something and end up where you started. And let's remember that symmetry is the original pattern of beauty in nature. But those pieces of uniqueness somehow contain the whole worldness of otherness and irreducible difference. They are rather asymmetries which can't be rectified. Or, as in the splendid poem of William Blake, "The Tyger", are they fearful symmetries?:

What immortal hand or eye /Could frame thy fearful symmetry?

What immortal hand or eye /Dare frame thy fearful symmetry?

The artistry could forge the fearful symmetry or maybe the affliction dares to free the fearful symmetry? Most probably both.

Fundamental relations are exactly what physicists are looking for because they are "generalisable", meaning they can describe unusual physical systems just as well as the original data set that the relation was discovered from – and, as such, are a distinguished feature of understanding. Uniqueness will define what would be a *skewed symmetry* in order to be "competent to comprehend the real". Such theories are not for an age, but for all time. Thomas Kuhn stated that "There are also extraordinary problems, and it may well be their resolution that makes the scientific enterprise as a whole so particularly worthwhile. But extraordinary problems are not to be had for the asking" [2].

Uniqueness is strongly correlated with *essentialization.* This is clearly indicated by Einstein: "It can scarcely be denied that the supreme goal of all theory is to make the irreducible basic elements as simple and as few as possible without having to surrender the adequate representation of a single datum of experience" [11]. So, science is working in that sense: to simplify a phenomenon to its essence in order to study it easily without losing anything important in the analysis. That is *essentialization.* Theoretical models of natural phenomena and scientific concepts of the highest importance suffer from a lack of data on the basic physical quantities. To overcome such situations there is only one tool: powerful models capable of simulating with sufficient accuracy real phenomena. I propose here two examples of essentialization. Both in the field of climate science. The first is Edward Lorentz's result, in 1963, on meteorological unpredictability. He adopted a very simple model, essentially simulating the atmospheric dynamics, by studying the heating of an air layer from the bottom surface on which it is reposing and the resulting air movement by means of a very simplified system of equations. By using a primitive – in our terms of today – computer, he observed that small errors, viewed as negligible, set in the input data, were actually catastrophic in the end, which led him to the conclusion - rejected initially by the scientific community - that a long-term prediction of weather is impossible. The second is the work of Syukuro Manabe and Richard T. Wetherald (Nobel Prize for Physics in 2022), in 1967, simulating the response to the change in atmospheric concentration of carbon dioxide. They used a very simple one-dimensional, single-column model of the atmosphere radiative-convective equilibrium with positive feedback effect of water vapor and they found that the temperature increases at the Earth's surface and in the troposphere, whereas it decreases in the stratosphere. Both results are fundamental to the present knowledge of climate change. How exactly the essence of objects, their generic properties, are *explanatory fundamentals,* like the two mentioned here, against any other non-essential properties? Truth is not significant if truth is not checkable at least in principle. Because truth is a relation of sentence to facts, undecided mathematical sentences do express our lack of knowledge of mathematical facts existing independently of proof systems. "I have shown on every formula of the restricted predicate calculus that it is either demonstrable as universally valid or else that a counter-example exists" [27] (p. 66, footnote 55). The Gödelian argument, quite reasonably therefore, attempts to draw philosophical conclusions from the meta-logical status of the truth, which is valid both intuitively and logically.

There could be several licit philosophical readings of the same scientific result. Such a meta-philosophical pluralism could mean giving up the confusion of philosophy with science but doesn't preclude or eliminate the fruitful cooperation between them since "knowledge is the perfect record of things which are certain", said Dante [9]. Scientific knowledge is never an absolute certainty; it is provisional. Yet, there is also a necessary certainty on which many other things can be and have been built. The truth is that everyone appropriates: it's how culture moves, it's how we learn.

5. Global Behavior and Cultural Code in Complex Systems

Global behavior is not necessarily a characteristic of our day. We assumed quite quickly, starting with the end of the cold war, the trinome global - globality - globalization, and today we are in a position to try to understand, at least, what global behavior is. One could argue that he exists as well as others argue the opposite. We cannot simply hold only positive and rational explanations in philosophy of knowledge and ignore the powerful emergence of unexplained unpredictable events/accidents. Pure faith, the opposite of all-rational, is also to deny a place to accidents. Allow me to recall a sportive moment loaded with huge public emotion: how to explain the fabulous comeback of the Real Madrid team against Manchester City, in the last two minutes of prolongation of the soccer match in the semifinal of Champions League in 2022? Information about low-likelihood of high-impact events through gathering vast amounts of data related to such events is not enough in order to achieve a credible and useful probability or estimation of the possible consequences.

It is imperative to study the dynamics of the system by simulating its behavior under very small perturbations combined with the theoretical models for improving the knowledge of the inner mechanisms. Kolmogorov, founder of the theory of probabiliy, explains how mathematics builds such models: "Mathematics is actually an instrument of thought (for thought). It is an extremely important one in a world where feedback and nonlinearities abound. The models used to simulate and calculate nonlinearities are increasingly sophisticated. Because that's how you get more and more valuable results. Linear models are honest, but also a little sad and depressing: efforts are proportional to results. However, in the non-linear world, an input no matter how small (infinitesimal) can have a macroscopic output (or vice versa). To understand: if electronics were linear we would have neither computers nor TV. In fact, we would not read these lines" [32]. My intuition on this matter is that linearity tends to make intuition and feeling irrelevant. Fluctuations, generated by controlled or accidental perturbations, and

displaying off-equilibrium behavior have to be studied to find out if the systems under consideration are in a state of a single equilibrium state or they are complex systems with multiple equilibria. In some cases we should be able to assess the risk in the case of lower consequences and maybe be able to translate the qualitative results to other, much more exposed cases to those negative impacts. Scientists specialised in weather prediction, for example, have shown that a number of catastrophic events could have been foreseen with data available at the time. They were not unpredictable but were not taken into consideration and became *de facto unpredictable.* Noson S. Yanofsky explained that "Kolmogorov's complexity theory teaches us that, at the deepest level, there is no sure way to determine the best pattern. We will simply never know if the pattern that we have found is the best one" [33]. Human development is based on interactionism and interdisciplinarity is an essential part of it. The purpose of logical systems in society is to model the attitudes of people, individually as well as in the environment context. "Within the system a person develops and operates as an integrated, comprehensive and dynamic unit" is a recent statement of social science [34]. In the meantime the functioning of the environment depends on the individual's workings. Understanding both ways, individually and environmentally, makes us (or should) *doubly conscious* of the dynamic process of observation, communication and inference. This should be related, although we don't know how, to the purely biological fact that microscopic structures of the brain (mitochondria) are the engines of our thoughts and feelings, powering our mental activities and ensuring normal cognitive function. Within this process there are exceptionally important compensatory mechanisms such as "cognitive reserve" (kind of spare mental capacity) which increases with years of education and learning and is capable of back-up brain circuitry, because learning promotes denser circuitry and more synapses. The question now is how to continue exploring global behavior. Neuroscientists investigate global behavior as a global workspace combined with integrated information. In fact we expect how to work out what it tells us about what can be done now for tomorrow to be more resilient and more predictable. The universe is a probabilistic place, at least from the vantage point of an individual living in it, and coming to terms with unanticipated outcomes (ensuring stability) is evidently important.

Transdisciplinarity, not just interdisciplinarity, as we see it in every mundane or extraordinary event, is the fundamental modality of globalization in culture with its two pillars: globalization of the knowledge process and the communicational, informational and computational globalization. The phenomena studied in the social and behavioral sciences are inherently unpredictable and indeterminate. They display the traits of complex systems. There are compelling reasons to believe that it is impossible to make accurate, nontrivial predictions concerning human behavior. Even infinitesimally tiny initial differences in any of a multitude of factors (e. g., learning, teacher attention, teaching materials, motivation, home background, student background knowledge) could in the course of time lead to significant and totally unpredictable differences in outcomes. The interacting nature of aptitude, treatment, and time variables means that "we cannot store up generalizations and constructs for ultimate assembly into a network. It is as if we needed a gross of dry cells to power an engine, and could only make one a month. The energy would leak out of the first cells before we had half the battery completed" says Garry Cziko [35]. Social media has become a battleground for controlling human attention. Vast amounts of energy, time and capital are devoted to creating imaginary universes. With the new generation of AI, the battlefront is shifting from attention to intimacy. In the coming decades we might find ourselves living inside the dreams of an alien intelligence. AI offers a risk-averse landscape selling to the global audience very questionable values. The risks are high entering a poor cultural and moral territory. Maybe changing the whole orbit of thinking. *I share, therefore I am* seems to be the new mantra. But also *Technology makes us forget what we know about life.* With no experience of real life or human communication the AI-Large language models offer nothing more than the ability to parrot things they have heard in training, an ability to analyze huge amounts of numbers, frequently surprising their creators, but which is nothing like thought. But wouldn't humans wielding AI as tools be the ones that should end up in control? It just means society needs to reason about it in the same way as other complex social issues, among them the unpredictability of such superintelligent systems. The coming of ubiquitous pseudo-cognition along these lines could be a turning point in history. Some AI researchers are neglecting ethical responsibilities and betraying the public trust. Fear of AI has haunted humankind for only the past few decades. But for thousands of years humans have been haunted by a much deeper fear. Since ancient times humans have feared being trapped in a world of illusions. Some call AI a "new weapon of mass destruction" that can annihilate our mental and social world. Alan Turing cautioned us at the very beginning of the computer era that we should expect "machines to take control". "The view that machines cannot produce surprises is due to an error of thought... Namely, the assumption that as soon as a fact is presented to us, all its consequences play out immediately and simultaneously in our minds. It's a very useful assumption in many circumstances, but we forget too easily that it's false" [36]. Many real situations in our so-called developed world of today are testimonies of the numerous crises that result when an "atmosphere of fear interacts with the logic of law enforcement, which holds that quick-trigger use of force is always justified by what *might* have happened" [37]. What kind of interaction is this? An unexpected one or a new normal? Let's remember Cicero's *homo novus* and ask if what happened then, when "personal interests united people against public interests and implacably hostile enemies as of yesterday, were found the next day, shoulder to shoulder, on the same bench, as best friends", is a human behavior unchanged two millennia later

[38]. Edgar Morin says that man is "foolish-wise" and therefore, "it is a question of asking whether the progress of complexity, ingenuity, intelligence, and society have been made despite, with or because of disorder, error or fantasy. And we will respond because of, with and despite at the same time; the right answer can only be complex and contradictory" [27]. It is then appropriate to think that the health of social and economic systems can be ensured by a mixture between, on the one hand, feedback and regulations and as much flexibility as possible, and room for creativity, innovation and adaptation to new conditions, on the other hand. This would be what would be the dynamics of complex systems at the *edge of chaos*. The term is borrowed from biology where it designates a critical point very similar to the critical threshold in physics. That dynamic is in fact a competitive struggle, very similar to the Darwinian selection, to eliminate all possible scenarios which are unfit before it is too late to build or rebuild resilience. Complex systems are everywhere and very different, from atmosphere to ecosystems, optimization problems or behavior of community living beings or artificial networks. Giorgio Parisi, founder of complex systems theory (Nobel Prize for Physics in 2022), has underlined that: "Criticality is not uncommon in biological systems made up of many interacting components. Being critical is a way for the system to be always ready to optimally respond to an external perturbation, such as a predator attack as in the case of bird flocks" [39]. The coordination capacity of flocks of starlings, as measured by intense observation of these, show that the correlation remains very strong, not decaying with distance. Although there is a scale-free behavior, "how starlings achieve such a strong correlation remains a mystery to us", says Parisi. Thus, the flock of starlings constitutes a complex system and their behavior (achieving a strong correlation) is not yet explained.

Why and how complex systems (biological in the first place) move to the edge of chaos? And what do they do to stay there? They are in constant struggle to create or keep order in complexity. That is the pattern of self-organization, the specific feature of human nature. Some scientists, from different fields, say: we are aware of the arrow of evolution, and we try to control future evolution. Can we? History doesn't prove that. First of all, control over everything and steering with sure hand the future is an illusion. Darwinian selection implies accident, randomness. But also, simplicity is the aspiration of nature. Our original complexity evolved tremendously and continues to evolve towards new, more efficient and resilient forms. "We have, on the one hand, life experience taken over and assimilated and established in society as norm and, on the other hand, experience gained from real life events, unlived yet. Norm and chance follow each other rather chaotically. The duration of validity of a norm and the moment of occurrence of the random event are unpredictable. However, norms and events coexist in our consciousness" [1]. I would now use conviviality instead of coexistence. Stuart Kauffman, from the perspective of mathematical biology of self-organization , also believes that it is something in-between: "I suspect that the fate of all complex adaptive systems in the biosphere—from cells to the economy—is to evolve toward a natural state between order and chaos, a great trade-off between structure and surprise" [40]. I think he should have not disregarded the important contribution to organization of the above mentioned energies, along with self-organization as a highway. Moreover, culture is a generative system which is functioning with those energies intertwined to power artistic or scientific prowess. Culture is a system of high complexity while hubris, a permanent source of disorder and low complexity, could collapse it to a low level. "The cultural code maintains the integrity and identity of the social system, ensures its auto perpetuation or its invariant reproduction, protecting it from uncertainty, chance, confusion, disorder", says Edgar Morin [6]. This kind of movement to a *cultural edge of chaos* could display - why not? - the critical threshold feature in its dynamics. How far are we now, at the moment of analysis, from the internal moment of reaching the critical threshold in the system? At least from the moral perspective. And we properly understand from many of the most admirable pieces of universal literature, such as this one written by Joseph Conrad: "It is not Justice the servant of men, but accident, hazard, Fortune—the ally of patient Time—that holds an even and scrupulous balance". Therefore, "resolve fixedly never, through any possible motives, to do anything which you believe to be wrong" ([3], p. 200, p. 214).

6. Probabilities and the Connection to Real Life and Unpredictable Events

Probability defined as a probable state of nature, means that that state has a high probability of occurring. This notion is necessarily linked to randomness causing unpredictable and surprising effects. According to Ian Hacking, the only way for an opinion to gain probability is to obtain approval by people with important social status [41]. The subject is in many ways the same as stated by Spinoza three centuries before: "Fame has the further drawback that it compels its votaries to order their lives according to the opinions of their fellow-men, shunning what they usually shun, and seeking what they usually seek" [42]. Indeed, an opinion is based on probability, which means primarily on the authority of those who endorse it. Hacking believes that probability is related to the modern notion of evidence. This evidence is testimonial in nature or books or other more modern tools. Since Plato, philosophical thought has wanted to establish a distinction between knowledge and opinion. Schopenhauer wanted to taught us, a century before Hacking but two centuries after Spinoza, "The art of being right": "Every man prefers belief to the exercise of judgment, says Seneca (*Unusquisque mavult credere quam judicare*); and it is therefore an easy matter if you have an authority on your side which your opponent respects… Authorities which your opponent fails to understand are those of which he generally thinks the most" [43]. One example from financial matters is interesting. The idea that inflation at 2 percent annually, not, say, 4 percent, is

the appropriate inflation target viewed as a consensus today. "The analytical and empirical basis for that consensus is quite weak" says Paul Krugman (Nobel Prize for Economy) [44], but central bankers have come to view restoring 2 percent as a test of their credibility. Anti-inflation policies are always damaging new investments but high inflation is a shocking source of uncertainty. Due to global unpredictability, high correlations between the use of different economic instruments and their consequences are not known. The story could be one of solid resilience or vast pain. The process of modeling the surrounding world, as suggested in the present article, is a process of approximation, in which uniqueness and essentialization are the characteristic traits that stay permanently in the realm of the fundamental results in science. In pragmatic terms, the process is somewhere in-between. "An approximate reasoning system provides something of middle ground between what is explicit or evident and can be retrieved using few resources and what is implicit and should be inferred given enough time and memory" [45]. The results we achieve by approximation as a method/system are part of speculative thinking and are not the approximative thinking which produces unintelligent, unfulfilled or unfinished realities. Speculative thinking is indeed an instrument to grasp facts of nature and life although sometimes it can overestimate improbable situations. In this case we are under a profound psychological effect. Maurice Allais (another Nobel Prize for Economy), who invented the paradox bearing his name, said this effect shows "(the human) preference for safety in the vicinity of certainty" [46].

The psychological state of humanity can't be a stable equilibrium but rather a swinging, beautiful if not perfect, between the will to belief and the obligation to doubt. It's the economic way of thinking. It's the disciplined thinking that is capable of eliminating the variability of expertise, so harmful at the moment of taking decisions based on expertise. The relationship between epistemology, in which the first condition is to define knowledge, and uncertainty is, indeed, subject to the fundamental relationship between attempts to theoretically model perceived reality and the observability of the universe. A philosophical system is "stable" if it is not only consistent, but if any of its theses does not create insuperable difficulties vis-à-vis other theses of the system. Naturally, the same should be valid in interdisciplinarity. Its truth value is dependent on facts which could lie beyond empirical evidence. The instability of the philosophical system comes from its "effort to both naturalize mathematical knowledge and to assume the bivalence of truth and Gödel's proof that mathematics does not consist in probability but in relation to mathematical facts" says Joseph Vidal-Rosset [47].

We undoubtedly need explanations as intuitive as possible. The clash between logic and intuition needs to be overcome at the moment of decision-making, I e. of synthesis. Otherwise we burden ourselves with a new, possible, uncertainty. Let us keep in mind that uncertainty is the great enemy of action. That is why our action is meant to build resilience to deal better with unpredictable events and prevent the emergence of a critical threshold. Resilience is not built in order to avoid risks. In fact, in the economy, absorbing risks is an imperative as it shows the way to economic progress. Many issues in logic today are no longer about zero-agent notions like truth, or single-agent notions like proof, but rather about processes of verification, argumentation, communication, or general interaction to define our priorities and decisions. And encourage a longer time-perspective, thinking within the past, present and future.

What is the connection to real life? is the question in an attempt to make a connection with what we actually experience. In our society the event (accident) occurs when:

1) we don't know how things work (we don't know the rules);
2) we do not pay full attention and therefore do not calculate with the necessary accuracy;
3) we interact with people who affect our own lives.

Note that this model includes the randomness defined basically in three ways: absence of rules, sensitivity to initial conditions, and external complexity.

As a matter of fact everything in our universe, according to the laws of fundamental physics, is subject to probabilities. "Matter *is* probabilities", says Ian Hacking, since the quantum particles are not only matter, but also waves defined by probabilities. He concludes even that "social statistics and quantum mechanics are.... part of the same formation" [48]. From this we can probably derive a more complete understanding of our world driven so often by chance. Kolmogorov did not think that every event has a probability. In 1951, in his article on probability in the Great Soviet Encyclopedia he is explicit: "Certainly not every event whose occurrence is not uniquely determined under given conditions has a definite probability under those conditions. The assumption that a definite probability (i. e. a completely defined fraction of the number of occurrences of an event if the conditions are repeated a large number of times) in fact exists for a given event under given conditions is a hypothesis which must be verified or justified in each individual case".

One can consider it useful to adapt the analogy of the dualistic philosophy used in modern physics in order to fathom out the unpredictability concept. The knowledge of nature is divided into facts and probabilities. Observation of the natural objects that are directly observable gives us facts about what happened in the past, but offers us only probabilities about what may happen in the future. Future is uncertain because in the intimacy of nature the processes are essentially not predictable. In nature, frictions of all sorts prevent turbulence (consisting of a chain of superimposed eddies) going on indefinitely. Typical of turbulent flow is the diffusive character of transport processes, owing to the randomness of the motion. This feature is absolutely basic. The structure of turbulence is self-preserving (a length scale and a velocity scale determine the structure) during decay. With turbulence, it's not just a case of physical theory being able to handle only simple cases - we can't do any. We have

no good fundamental theory at all. We are confronted with *compound disaster* – extreme events occurring either together or quickly one after the other, before recovery from the previous one (or ones) can play out. It was also a cascading disaster, where one extreme event triggers others. It could be very well a tipping point, an irreversible shift in Earth's natural systems caused by climate breakdown. The heat wave that hit China in August 2022 almost dried the Yangtze River, one of the largest rivers in the world. It is the most severe ever recorded on Earth and hydrologists explain this phenomenon by the complexity of the event: "It combines the most extreme intensity (of the heat wave) with the most extreme unfolding in time and over an incredibly large region, all at the same time. Nothing in the history of climate phenomena in the world compares to what happened in China" [49]. The photos of the moment show the dunes on the riverbed and almost no flow. That image was nowhere in our minds and in our previous understanding of nature. But, it is much more than that. In the same place, the Yangtze River, just two years earlier (July 2020), generated huge floods and millions of homes were abandoned, a phenomenon considered then as an absolutely unpredictable event by the hydrologists. So, the world isn't just burning, it is drowning too. In other words, abandon never the reality of the present for the fiction of the future. Today, the hydric crisis combined with floods of historically unrecorded amplitude are redefining the world economy. First, a war for water could be triggered any time soon, and simultaneously a huge effort has to be conducted to increase the resilience of human communities facing floods. Methods, validity, and scope of natural sciences presupposes choice in accordance to social needs; it must follow the fundamental problems we face. According to the empirical evidence in environmental sciences as shown by Nearing and al. [50], these problems are:

1) The problem of the finite number of experiments;
2) The problem of the finite number of hypotheses;
3) The problem of being able to test sets of hypotheses rather than individual hypotheses.

Indeed, we know that we can only perform a limited number of experiments and test only a limited number of hypotheses, and all of them are ultimately presented as a whole and not individually. A relevant example comes from the devastating floods in Germany in the Ahr valley in July 2021 traumatized the population of the region (there were 134 deaths). A resident said after the catastrophe: "Here was a small paradise, with vine plantations, a small river, and bicycle rides. Then, one night, everything went." The event radically changed the way people thought at the national level. People change their behavior especially when they are directly confronted with what is transforming their existence. It proves once again that the economic system, although develops through continuous change, is often precipitated by unpredictable events with a very low frequency of occurrence. To deal with this there are two options: make disaster-response systems work harder and faster or redesign them completely to deal with such events, though it didn't say how this might be achieved. The dynamic approach to system behavior is, or should be, a perspective that balances natural (or political) risk, vulnerability under risk and uncertainty, and ongoing consideration of connectivity. Time (history), sensitivity and vulnerability form a synthesis of the risk and the basis of an estimate of its probability. And, returning to the content of the synthesis: it can only be obtained through a vast interdisciplinarity. The risk landscape is evolving. So if you simulate probabilities of a rare event you need to take that against the backdrop of something that's changing. That makes it much more complex. Many natural processes exhibit so-called phase transitions, i. e. a behavior in which small changes in a system parameter produces a drastic change in its overall observed behavior. Such changes are marked by a critical threshold. Some important results describe phase transitions from demonstrable to unprovable statements through the variation of the parameter that characterizes a critical threshold. Thus, in the case of climate change, the study of the transition is fundamental to knowing how big its impact on humanity can be. Otherwise, instead of workable solutions to real crises we'll end up with completely unworkable solutions to largely imaginary ones.

7. Conclusions

We need to use solid results from a vast interdisciplinarity. The starting point could be what we mean by interdisciplinarity, but it is beyond my capacity. I'd rather wish to give a sense of the factors in play and the state of the debate and advance in the territory of how interdisciplinarity may help to solve problems which are common in many areas of knowledge. My background in science is turbulence and hydrology and when I moved to environmental science I got a good benefit from the enlarged interdisciplinary perspective. Uncertainty, indeterminacy, randomness, and contradictions appear, not as non-essential substances of debate to be eliminated by explanation, but as everlasting ingredients of our conception of reality. Indeed we are confronted with a new human landscape. The anomalies become the new normal, as shown by devastating floods or heat waves or the war in Ukraine. But how much further we advance in science depends on reducing uncertainty by forcing data or evidence to reveal more of the reality they contain. "Trust is often not given inversely proportional to the error or uncertainty, but often unrelated to them, that is, unrelated to the results of research on the uncertainty of the data or the results of the models used" says hydrologist K. J. Beven [51]. Let us keep in mind that uncertainty is the great enemy of action. That is why our action is meant to build resilience to deal better with unpredictable events. Many issues in logic today are no longer about central notions like truth or proof, but rather about processes of verification, argumentation, communication, or general interaction. Could we imagine that thinking which transcends scientific disciplines and cultural works could unite them into an ensemble - a kind of spectacle of thinking - for the purpose of enhancing strategic aptitudes (competencies) to resolve

problems of knowledge and decision? Something like *Gesamtdenkenwerk*? Human development is based on interactionism and interdisciplinarity is an essential part of it. To study the real world and the meaning that its members make of it and how they manage to maintain and achieve social order as a negotiated interactional accomplishment I think could be done from extracting or wielding both the energy of movement and the energy of interactions. Research in the social sciences is not fundamentally different from research in the physical sciences. The energy of movement is the force of life, in the present at least part of that force of humanity which shapes new spaces of information and communication, new horizons of artificial intelligence. Simplicity, beauty, rationalistic optimism, are features of unshakeable scientific results, which are evident in Einstein's relativity, Heisenberg's uncertainty, Gödel's incompleteness, Copernicus'revolution, Darwin's natural selection, for instance. But why not also in Da Vinci's universal language, Shakespeare's grasp of human condition, Beethoven's heroic and unwavering beauty of musical language, Brâncuși's art perfection in simplicity? We may call this feature of scientific theory or art *uniqueness.* Although such foundational results are solutions of the system, they challenge it. They are radical transformations of the vision about the system. Uniqueness is strongly correlated with *essentialization.* Science is working in that sense: to simplify a phenomenon to its essence in order to study it easily without losing anything important in the analysis. Here examples are given from climate science.

Our original complexity evolved tremendously and continues to evolve towards new, more efficient and resilient forms. "We have, on the one hand, life experience taken over and assimilated and established in society as norm and, on the other hand, experience gained from real life events, unlived yet. Norm and chance follow each other rather chaotically. The duration of validity of a norm and the moment of occurrence of the random event are unpredictable. However, norms and events coexist in our consciousness" I said in my previous article. I would now use conviviality instead of coexistence.

Can hazard have purpose and direction? By definition it's non-sense or at best a paradox. But the question may offer some consistent path to results. The idea is that the more effort we put into project design to cover as many details and possible consequences as possible we can grasp in our in-depth analysis aiming to create the project (in art or science or society), the greater the chances that the random occurrence of the unpredictable event will settle on the project's purpose and direction and not on contrary to them. There is no vicious circle here and this can explain many good results already obtained in such circumstances. Let us keep in mind that uncertainty is the great enemy of action. That is why our action is meant to build resilience to deal better with unpredictable events and prevent the emergence of a critical threshold. Resilience is not built in order to avoid risks. In fact, in the economy, absorbing risks is an imperative as it shows the way to economic progress.

Social media has become a battleground for controlling human attention. Vast amounts of energy, time and capital are devoted to creating imaginary universes. With the new generation of AI, the battlefront is shifting from attention to intimacy. In the coming decades we might find ourselves living inside the dreams of an alien intelligence. AI offers a risk-averse landscape selling to the global audience very questionable values. The risks are high entering a poor cultural and moral territory. Maybe changing the whole orbit of thinking. "I share, therefore I am" seems to be the new mantra. But also "Technology makes us forget what we know about life". Frank Ramsey ascertained that: "Roughly, reasonable degree of belief = proportion of cases in which habit leads to truth" [26]. Truth is not significant if truth is not checkable at least in principle. Here comes Gödel's famous statement about provability which shows that logic is not only implacable but also beautiful: "If provability in a formal system for arithmetic can be defined within the system, and truth cannot, then provability and truth are not the same thing. So either there are provable formulas that are not true, or there are true formulas that are not provable. In the first case the system is not correct because it contains the fake; in the second case it is not complete, because there are truths which it cannot demonstrate" [52]. I finish with another philosophical piece of poetry, in W. H. Auden, "We get the Dialectic fairly well", written 1941 and never published until 2022 in The New York Review of Books:

We get the Dialectic fairly well
Nothing is unconditional but fate.
To judge our sentence is to live in hell.
Whatever we obey becomes our fate,
That what we are, we only are too well.

References

[1] Petre Roman, "We Live Under the Permanent Conviviality of Norms and Chance--Understanding It Is Key to Building More Resilient Complex Systems", International Journal of Philosophy, Vol. 10, No. 4, 2022, pp. 147-152.

[2] Thomas Kuhn, "The Structure of Scientific Revolutions", Foundations of the Unity of Science, vol. I and II, University of Chicago Press, 1970, p. 61.

[3] Joseph Conrad, "Lord Jim", Wordsworth Classics, 2002, p. 32 and p. 138.

[4] Peter Ustinov, "The Old Man and Mr. Smith", Michael O'Mara Books Ltd, 1991, p. 305.

[5] Gh. Vlăduțescu,"O reconstrucție istorică a sistemului metafizicii" (*A historical reconstruction of the metaphysics sistem*), in Romanian, Editura Universității din București, 2017, p. 188.

[6] Edgar Morin, "Le paradigme perdu: la nature humaine", Éditions du Seuil, 1973, , p. 174, p. 173.

[7] Anthony Grafton, "History's Postmodern Fates", Daedalus, vol. 135, no. 2 , Spring, 2006, p. 62.

[8] Solomon Marcus, "The Art-Science Marriage, From Quarrel to Understanding", BRIDGES, Mathematical Connections in Art, Music, and Science, Conference Proceedings, Southwestern College, Winfield, Kansas, July 1998, p. 284.

[9] Dante, "The Convivio", Book 3, ch. 11.

[10] Jean Piaget, "Logique et connaissance scientifique", volume Encyclopédie de la Pléiade", ch. "L'épistémologie et ses variétés", 1967, p. 12.

[11] "Albert Einstein's comments on a collection of essays", in "Darwin to Einstein-Primary Sources of Science and Belief", Longman, Open University, 1980, p. 197.

[12] reported in Philipp Frank, "Einstein's Philosophy of Science", in "Darwin to Einstein-Primary Sources of Science and Belief", Longman, Open University, 1980, p. 152.

[13] George Orwell, "Burmese Days", Ed. Macmillan Collector's Library, 16, 1986, p. 265 and p. 166.

[14] see Ray Furness, introduction to "Twilight of the Idols", Wordsworth Classics of World Literature, 2007.

[15] Edward Mendelson, "The Secret Auden", The New York Review of Books, March 2014.

[16] Carlo Rovelli, "On the bizarre world of relational quantum mechanics", New Scientist, 10 October, 2022.

[17] Philip Ball, "The exotic quantum effects found hiding inside ultra-thin materials", New Scientist, 1 December 2022.

[18] Chanda Prescod-Weinstein, "Why uncertainty is part of science - especially quantum mechanics", New Scientist, 4 March 2023.

[19] D. C. Phillips, "Philosophy, science and social inquiry", Elmsford, NY, Pergamon Press, 1987.

[20] Anthony Grafton, "How to Cast a Metal Lizard", NYRB, September 22, 2022.

[21] A. B. Ranovici, "Elenismul și rolul său istoric" (*Hellenism and its historic role*), in Romanian, Editura de Stat pentru Literatura Științifică, 1953.

[22] Plutarch, "Selected Lives", Wordsworth Classics of World Literature, 1998, p. 391.

[23] Arthur Schopenhauer. "The world as will and representation", WordPress.com, p. 369.

[24] Giorgio Venturi, "Hilbert, Completeness and Geometry", Vol 9, No 2, Logic, RIFAJ - Italian Journal of Analytic Philosophy Junior, 2018.

[25] Ian Hacking, "The Taming of Chance", The Argument, Cambridge University Press, 1990, p. 1.

[26] Frank Ramsey, "The Foundations of Mathematics and other Logical Essays", edited by R. B. Braithwaite, London: Kegan, Paul, Trench, Trubner & Co., New York, 1931, Ch. VII, p. 198.

[27] Kurt Gödel, "On Formally Undecidable Propositions of Principia Mathematica and Related Systems", Vienna, 1930, Translated by B. Meltzer, Introduction by R. B. Braithwaite, University of Cincinnati, PDF, 1962, footnote 15, p. 41.

[28] Edgar Morin, "Method", Volume 1, "The Nature of Nature", Ed. Peter Lang, 1992, p. 13.

[29] Benedict de Spinoza, "On the Improvement of Understanding", Project Gutenberg, (7) (1).

[30] Jean Paul Sartre, "L'Être et le Néant", Gallimard, 1987, p. 569.

[31] Reported in Hao Wang, "From Mathematics to Philosophy", London, Routledge Kegan Paul, 1974, pp. 324-325.

[32] Andrey Kolmogorov, "Combinatorial Foundations of Information Theory and the Calculus of Probabilities", Russian Mathematical Surveys, vol. 38 (4), 1983, pp. 29-43.

[33] Noson S. Yanofsky, "Kolmogorov Complexity and Our Search for Meaning", Nautilus newsletter, July 31, 2018.

[34] D. Magnusson, H. Stattin, "The Person in Context: A Holistic-Interactionistic Approach", in R. M. Lerner & W. Damon (Eds.), "Theoretical models of human development", John Wiley & Sons, Inc., 2006, pp. 400-406.

[35] Garry A. Cziko, "Unpredictability and Indeterminism in Human Behavior", Educational Researcher, Vol. 18, No. 3, 1989, pp. 17-25.

[36] A. M. Turing, "Computing Machinery and Intelligence", Mind, 49, 1950, pp. 433-460.

[37] Rachel Bedard, "A Culture of Repression and Neglect", NYRB, 11 May 2023.

[38] Quoted in N. I. Barbu, "Scrisorile lui Cicero" (*Cicero's letters*), in Romanian, Editura Academiei R. P. R., 1959, p. 38.

[39] Giorgio Parisi, interview with Ginestra Bianconi, Journal of Physics: Complexity, 12th January 2023.

[40] Stuart A. Kauffman, "The Origins of Order: Self-organization and Selection in Evolution", Oxford University Press, 1993, p. 181. (53).

[41] Ian Hacking, "The Emergence of Probability", "Introduction 2006", Cambridge University Press, 2006, p. 12.

[42] Benedict de Spinoza, "On the Improvement of Understanding", Project Gutenberg, 2010, (5) (1).

[43] Arthur Schopenhauer, "The art of being right", Ed. Beers&Politics, 2017, p. 28.

[44] Paul Krugman, "Wonking Out: How Low Must Inflation Go?", New York Times, June 9, 2023.

[45] Eric Pacuit, "Logics of Informational Attitudes and Informative Actions", Journal of Indian Center of Philosophical Research, Volume XXVII, Number 1, January-March 2010.

[46] Maurice Allais, "The So-called Allais Paradox and Rational Decisions Under Uncertainty", in "Expected Utility Hypotheses and the Allais Paradox", Allais et Hagen, editors, 1979.

[47] Joseph Vidal-Rosset, "Does Gödel's Incompleteness Theorem Prove That Truth Transcends Proof?", Researchgate.net/publication/226670228, January 2006.

[48] Quoted from "China's worst heatwave", New Scientist, 27 August 2022.

[49] G. S. Nearing, Y. Tian, H. V. Gupta, M. P. Clark, K. W. Harrison, S. V. Weijs, "A philosophical basis for hydrological uncertainty", Hydrological Sciences Journal, vol. 61, 2016, pp. 1666-1678.

[50] K. J. Beven, "Facets of uncertainty: epistemic uncertainty, non-stationarity, likelihood, hypothesis testing, and communication", Hydrological Sciences Journal, vol. 61, 2016, pp. 1652-1665.

[51] Gödel letter to Ernest Zermelo, 1931, quoted in Piergiorgio Odifreddi, "Il dio della logica", Longanesi, 2018, p. 92.