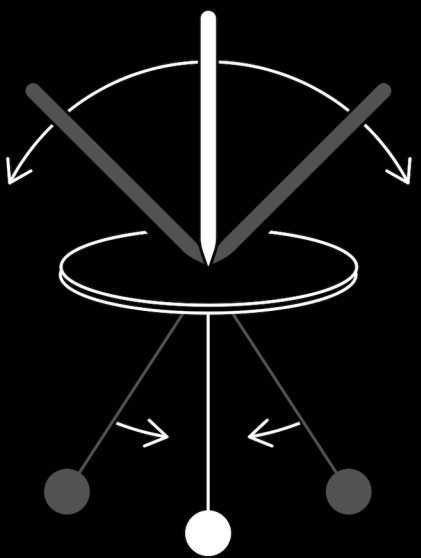
AutoRicerca 18

Journal of inner research | Year 2019



The secret of life

English edition

autoricerca.com

autoricerca.com

AutoRicerca

No. 18, Year 2019

AutoRicerca: No. 18, Year 2019
Editor: Massimiliano Sassoli de Bianchi
Cover: Luca Sassoli de Bianchi

AutoRicerca (ISSN 2673-5113) is a publication of the *LAB – Laboratorio di AutoRicerca di Base* (www.autoricerca.ch), c/o *Area 302 SA* (www.area302.ch), via Cadepiano 18, 6917 Barbengo, Switzerland.

INDEX

autoricerca.com

WARNING

The pages of a book, whether paper or electronic, possess a peculiar property: they are able to accept whatever variety of letters, words, phrases and illustrations, without ever expressing a criticism, or disapproval. It is important to be aware of this fact when we go through a text, so that the lantern of our discernment can always accompany our reading. To explore new possibilities, we must remain open-minded, but it is equally important not to succumb to the temptation to uncritically absorb everything we read. In other words, the warning is to always subject the content of our reading to the scrutiny of our critical sense and personal experience.

The editor and the authors can in no way be held responsible for the consequences of a possible paradigm shift induced by the reading of the words contained in this volume.

autoricerca.com

EDITORIAL / EDITORIALE

[*Per l'editoriale in italiano, vai a pagina 12*]

This eighteenth volume of *AutoRicerca* (the second of Year 2019) is the first to be published only in English. The journal already offered English editions of two journal's issues (more specifically, issues 12 and 16), which however were just published in parallel with the Italian ones. In the present case, there is no corresponding volume available in Italian.

Considering that *AutoRicerca*'s primary mission is to publish writings in Italian, on the broad topic of inner (and outer) research, as also suggested by the distinctive Italian name of the journal (which translated into English would be *Self-Reasearch*), this choice may seem unusual, if not contradictory. Let me try to explain what the main reasons for it are.

Of course, translating texts originally in English, or in other languages, into Italian, and doing it properly, takes time. Since this is something I personally do, and that time is a very rare "substance," when I have some interesting original material in English I am often tempted to leave it as it is and simply open the journal to a more international audience, by also allowing the publication of issues available only in English.

On the other hand, in the present case it was not so much the 'lack of time' that motivated the choice to have a first volume only in English, but the content of what I had to translate, which in my opinion did not lend itself well to this operation, and this essentially for two reasons. The first, is that part of the volume is dedicated to a conversation that happened on *Facebook*, between four people with very different orientations, if only for what

concerns their main professional activities. Two are physicists (*Diederik Aerts* and *Massimiliano Sassoli de Bianchi*), members of so-called 'Brussels group', one is a Buddhist priest of the Rinzai School, one of the three schools of Zen Buddhism existing today (*Kigen William Ekeson*), and finally the fourth person is an artist-publicist (*Valéry Schneider*).

These four individuals found themselves over a period of about two months to comment on a short post published by Aerts, entitled "The secret of life." Although the expressive form of the comments that emerged is excellent, as the interlocutors truly made an effort to communicate their ideas in a well-structured and precise way, the exchange remains informal and therefore it is not always obvious to translate it without altering the communicative style of the debaters.

The second reason to stop me from making an Italian translation of the present volume, is the publication in it of an article by Aerts entitled "Quantum theory and conceptuality: matter, histories, semantics and space-time." This paper presents countless linguistic examples (and related word counts, via search engines on the Web) that use the fact that certain words acquire different meanings depending on the context in which they are expressed, such as the English word 'bank', which can indicate a financial institution or a place where to fish. The translation of these examples into Italian is not always evident, nor in some respect desirable (although, strangely enough, the only existing published version of the article, in the journal *Scientiae Studia*, is in Spanish, whereas the original English version only existed so far as a preprint uploaded on the *arXiv.org*.[1])

The reason for publishing in this volume the 2013 article by Aerts is that the author explicitly mentions it during the exchange, advising its reading to better understand and deepen some of the arguments he presents. Of course, in the 5 years following the publication of the article, other works have been published whose

[1] In many fields of mathematics and physics, but also of computer science, quantitative finance and biology, most of the publications in the form of preprints are uploaded to the repository *arXiv.org*, by *Cornell University*, accessible by everyone via the Internet.

reading is certainly also more than recommended, for those wishing to deepen the vision offered by the *Conceptuality Interpretation* initially proposed in 2009 by the author.

For example, I can recommend reading the review article of 2018 entitled "On the conceptuality interpretation of quantum and relativity theory." This is an open access text[2] of which I hope to be able to provide an Italian translation in an upcoming volume of *AutoRicerca*. There is also a video on *YouTube* that summarizes the content of this long article, based on a conference given by Sassoli de Bianchi at the *Worlds of Entanglement* Symposium (WOE), held at the *Free University of Brussels* in September 2017 and organized by the *Center Leo Apostel* (CLEA) *for Interdisciplinary Studies*.[3]

This number 18 of *AutoRicerca* also contains an interesting article by Ekeson, on the challenging topic of complexity. In this case too, the content of the article is mentioned by the author during the conversation, as a text where one can deepen and better understand his ideas. Since this is a work that has remained unpublished until today (although it was available online), it is with pleasure that I can, synergistically, propose its publication in this volume.

It is important to point out that Ekeson is not a scientist with an academic background, as he himself explains very openly in his article, which he considers, I quote his words: "a philosophical thought experiment using broad swaths of different phenomena as a way to explore a link between entities exhibiting teleological agency and all other entities."

Undoubtedly, the curiosity and scientific culture of Ekeson, combined with his interest in the reflection on the foundations of reality, have been among the propellers of the conversation that is presented in the pages that follow, cadenced by his questions, his constructive objections and his personal reflection.

The same is true of the contributions offered by Valéry

[2] Aerts, D., Sassoli de Bianchi, M., Sozzo, S. et al., *Found Sci* (2018); *https://doi.org/10.1007/s10699-018-9557-z.*

[3] *https://youtu.be/-SteQN1A33M.*

Schneider, who thanks to her particular view on reality, decidedly eclectic and multifaceted, has been able to push the conversation towards moments of greater clarification, also offering alternative perspectives on some of the issues examined.

The fourth interlocutor, Massimiliano Sassoli de Bianchi (that it is not a mystery to anyone, is also the Editor of *AutoRicerca*, hence the person writing the present editorial), collaborates with Aerts in different research fields, in particular the foundations of quantum theory, the general description of measurement processes, *quantum cognition* (i.e., the application of the quantum mathematics in the modeling of human cognitive processes) and more recently also the elaboration of the *conceptuality interpretation*. Obviously, as the reader will notice it easily when reading the exchange, the views offered by Aerts and Sassoli de Bianchi usually coincide, being in part the result of a shared research program.

As always, I wish you an enjoyable reading and a productive study of the content of this volume.

The Editor

Questo diciottesimo volume di *AutoRicerca* (il secondo del 2019) è il primo ad essere pubblicato unicamente in inglese. La rivista ha già presentato edizioni inglesi di due dei suoi numeri (più precisamente, i numeri 12 e 16), che tuttavia sono state unicamente pubblicate in parallelo con le edizioni in italiano. In questo caso, non c'è un volume corrispondente disponibile in italiano.

Considerando che la missione primaria di *AutoRicerca* è quella di pubblicare scritti in italiano sul vasto tema della ricerca interiore (ed esteriore), come indicato anche dal nome propriamente italiano della rivista (che tradotto in inglese, diverrebbe *Self-Reasearch*), questa scelta potrebbe sembrare insolita, se non contraddittoria. Vorrei quindi spiegare alcune delle ragioni di tale decisione.

Ovviamente, tradurre testi dall'inglese, o da altre lingue, all'italiano, e farlo correttamente, richiede tempo. Dal momento che eseguo personalmente le traduzioni, ed essendo il tempo una "sostanza" rara, quando ho in mano del materiale originale in inglese sono spesso tentato di lasciarlo tal quale e semplicemente aprire la rivista a un'audience più internazionale, consentendo anche la pubblicazione di numeri disponibili unicamente in inglese.

D'altra parte, in questo caso non è stata tanto la 'mancanza di tempo' a motivare la scelta di avere un primo volume solo in inglese, quanto il contenuto di ciò che avrei dovuto tradurre, che secondo me si prestava male a tale operazione, e questo per essenzialmente due ragioni. La prima è che una parte del volume è dedicata a una conversazione avvenuta su *Facebook*, tra quattro persone con orientamenti assai differenti, se non altro per quanto attiene alle loro attività professionali principali. Due sono fisici (*Diederik Aerts* e *Massimiliano Sassoli de Bianchi*), membri del cosiddetto 'Brussels group' (gruppo di Bruxelles), una è un sacerdote buddista della Scuola Rinzai, una delle tre scuole del Buddhismo Zen oggi esistenti (*Kigen William Ekeson*), ed infine la quarta è un'artista-pubblicista (*Valéry Schneider*).

Queste quattro persone si sono ritrovate in un arco di tempo di circa due mesi a commentare un breve post pubblicato da Aerts, intitolato "Il segreto della vita". Sebbene la forma espressiva dei commenti che sono emersi sia di ottimo livello, dacché gli interlocutori hanno fatto uno sforzo reale nel comunicare in modo articolato e preciso le loro idee, lo scambio resta di natura informale e in tal senso non sempre evidente da tradurre senza alterare lo stile comunicativo degli interlocutori.

La seconda ragione ad avermi frenato dal realizzare una traduzione in italiano di questo numero è la pubblicazione nello stesso anche di un articolo di Aerts intitolato "Teoria quantistica e concettualità: materia, storie, semantica e spazio-tempo" (Quantum theory and conceptuality: matter, stories, semantics and space-time). Questo articolo presenta innumerevoli esempi linguistici (e relativi conteggi di parole, tramite motori di ricerca sul Web), che utilizzano il fatto che determinate parole

acquisiscono significati differenti a seconda del contesto in cui si esprimono, come ad esempio la parola inglese "bank" (banca) che può indicare un istituto finanziario oppure un posto dove andare a pescare (riva, sponda). La traduzione di questi esempi in italiano non è evidente, né per certi versi auspicabile (sebbene, stranamente, l'unica versione ufficialmente pubblicata di questo articolo, nella rivista *Scientiae Studia*, sia in spagnolo, mentre la versione originale in inglese esiste unicamente come *preprint* archiviato su *arXiv.org*.[4])

La ragione della pubblicazione in questo volume dell'articolo di Aerts del 2013, è che l'autore lo menziona esplicitamente nello scambio, consigliandone la lettura per meglio comprendere e approfondire alcuni degli argomenti da lui presentati. Naturalmente, nei 5 anni seguenti la pubblicazione di questo articolo, altri lavori sono stati pubblicati la cui lettura è sicuramente più che consigliata, per chi volesse approfondire la visione offerta dall'*Interpretazione Concettualistica* inizialmente proposta nel 2009 dall'autore.

Posso ad esempio consigliare la lettura dell'articolo di rassegna del 2018 dal titolo "On the Conceptuality Interpretation of Quantum and Relativity Theories" (Sull'interpretazione concettualistica della teoria quantistica e relativistica). Si tratta di un testo ad accesso aperto[5] di cui spero poter fornire una traduzione in italiano in un prossimo numero di AutoRicerca. Esiste tra l'altro anche un video su *YouTube* che sintetizza i contenuti di questo lungo articolo, che si basa su una conferenza tenuta da Sassoli de Bianchi al Simposio *Worlds of Entanglement* (WOE), tenutosi presso la *Free University of Brussels* nel settembre del 2017 e organizzato dal *Center Leo*

[4] In molti campi della matematica e della fisica, ma anche dell'informatica, della finanza quantitativa e della biologia, buona parte delle pubblicazioni sotto forma di "bozze definitive" (dette "preprint") vengono caricate nell'archivio *arXiv.org*, della *Cornell University*, accessibile da tutti via Internet.

[5] Aerts, D., Sassoli de Bianchi, M., Sozzo, S. et al., *Found Sci* (2018); *https://doi.org/10.1007/s10699-018-9557-z.*

Apostel (CLEA) *for Interdisciplinary Studies*.[6]

Questo numero 18 di *AutoRicerca* contiene anche un interessante articolo di Ekeson, sul difficile tema della complessità. Anche in questo caso, il contenuto dell'articolo viene evocato dall'autore nel corso del dialogo, come testo dove approfondire e meglio comprendere le sue idee. Trattandosi di un testo rimasto ad oggi inedito (sebbene fosse disponibile online), è con piacere che posso proporlo, sinergicamente, nell'ambito di questo volume.

È rilevante precisare che Ekeson non è uno scienziato con una preparazione accademica, come egli stesso precisa molto apertamente nel suo articolo, che considera, cito qui le sue parole: "un esperimento di pensiero filosofico che usa un ampio spettro di diversi fenomeni come modo per esplorare un legame tra entità che esibiscono auto-iniziativa teleologica e tutte le altre entità."

Indubbiamente, la curiosità e cultura scientifica di Ekeson, combinata al suo interesse per la riflessione sui fondamenti del reale, hanno costituito il motore della conversazione presentata nelle pagine che seguono, cadenzato dalle sue domande, dalle sue obiezioni sempre costruttive e dalla sua personale riflessione.

Lo stesso vale per i contributi offerti da Valéry Schneider, che forte del suo particolare sguardo sul reale, decisamente eclettico e poliedrico, ha saputo spingere la conversazione verso momenti di maggiore chiarificazione, offrendo anche prospettive alternative su alcuni dei temi esaminati.

Il quarto interlocutore, Massimiliano Sassoli de Bianchi (che non è un mistero per nessuno, è anche l'editore di *AutoRicerca*, quindi la persona che sta scrivendo questo editoriale) collabora con Aerts in diversi settori di ricerca, in particolar modo i fondamenti della teoria quantistica, la descrizione generale dei processi di misura, la *quantum cognition* (cioè l'applicazione della matematica quantistica nella modellizzazione dei processi cognitivi umani) e più di recente anche l'elaborazione dell'*interpretazione concettualistica*. Ovviamente, il lettore se

[6] *https://youtu.be/-SteQN1A33M*.

ne accorgerà facilmente nel corso della lettura della conversazione, le prospettive offerte da Aerts e da Sassoli de Bianchi spesso coincidono, essendo in parte il risultato di un programma di ricerca condiviso.

Concludo questa versione italiana dell'editoriale traducendo qui di seguito il contenuto del breve post di Aerts che ha dato il via alla conversazione da cui è poi nata l'idea di questo volume.

Il Segreto della vita
Diederik Aerts

Nessuno ha mai promesso che le cose sarebbero state facili, e non lo sono. Nessuno ha mai promesso che la sofferenza non sarebbe stata intrinsecamente parte della vita, anche parte della tua vita, ed è così.

Nessuno ha mai promesso diversamente, vale a dire che ogni volta, di nuovo, i problemi sarebbero sorti, alcuni difficili, forse alcuni terribilmente difficili, e alcuni meno difficili, ed è così che stanno le cose.

Nessuno ha mai promesso che sarebbe stato possibile risolvere anche i più piccoli di questi problemi al primo tentativo, senza parlare di quelli più difficili, e così è.

Nessuno ha mai promesso che il male non sarebbe stato in agguato, soprattutto in quei luoghi dove può nascondere meglio la sua natura, e così è.

La breve descrizione di cui sopra, è una valida caratterizzazione della vita in profondità, e sappiamo perché lo è, perché noi, in quanto esseri umani, ci siamo svegliati ad essa nella coscienza.

Questa è la sua natura, perché la vita è la scelta irreversibile fatta momento dopo momento, è la costante lotta, contro la regressione spontanea verso l''essere solamente', che al livello locale di un corpo umano denominiamo morte.

Ogni respiro, ogni boccone di cibo, ogni passo, ogni sorriso, ogni abbraccio, ogni sprazzo d'amore,

> compassione, collaborazione, costruzione, creazione, sono piccole parti di questa costante lotta contro l''essere solamente', o morte locale, il contenuto della seconda legge della termodinamica e, a un livello di fisica più profondo, la separazione della materia dall'antimateria nel tempo.
>
> Come piccoli individui umani siamo umili partecipanti in questo grande impegno di vita, in questa grande impresa di sforzo e lotta, in questa profonda perseveranza della sofferenza, in questo tentativo senza fine di risolvere problemi, fallendo e riprovando, e a volte raggiungendo una vittoria locale e modesta.
>
> Il segreto profondo della vita è che se persegui un nobile obiettivo, tutte le caratteristiche della vita descritte sopra diventano la sostanza del significato, che è il cibo della mente umana.

Naturalmente, per chi non conosce l'inglese, o non lo padroneggia ancora a sufficienza, il consiglio è di dedicare del tempo, o più tempo, all'apprendimento e/o perfezionamento di questa lingua, a prescindere dall'età anagrafica, considerando l'importanza che riveste oggi per quanto concerne l'acquisizione, produzione e diffusione della conoscenza su scala planetaria.[7]

Come sempre, vi auguro una buona lettura e uno studio produttivo dei contenuti di questo volume.

L'Editore

[7] L'inglese è senza dubbio diventato oggi il "nuovo latino", non solo perché è l'idioma del mondo globale, ma perché è stato adottato come lingua della scienza e della tecnologia, e ovviamente del commercio.

ABOUT THE AUTHORS

Diederik Aerts received his MSc in Mathematical Physics in 1975, from Brussels Free University (VUB). For his doctorate he worked at the University of Geneva with Constantin Piron on the Foundations of Quantum Theory, obtaining his PhD in Theoretical Physics in 1981 from VUB, with Jean Reignier. In 1976 he started working as a researcher for the Belgian National Fund for Scientific Research (NFWO), where in 1985 he became a tenured researcher. Since 1995, he has been director of the VUB's *Center Leo Apostel for Interdisciplinary Studies* (CLEA) and in 2000 he was appointed professor at the VUB. From 1990, he has been a board member of the 'Worldviews group', founded by the late philosopher Leo Apostel. In 1997, he became Editor-in-Chief of the international ISI and Springer journal 'Foundations of Science (FOS)'. He was the scientific and artistic coordinator of the 'Einstein meets Magritte' conference, where some of the world's leading scientists and artists gathered to reflect about science, nature, human action and society. For more information, please refer to the author's personal website: *www.vub.ac.be/CLEA/aerts*.

Kigen William Ekeson is a Rinzai Zen Buddhist priest living in Vienna, Austria. He began his formal study of Zen Buddhism in 1987 at the Cambridge Buddhist Association under Myoan Maurine Stuart, Roshi. In 1988, he moved to the Rinzai-ji Zen temple in Los Angeles to continue his study under Joshu Sasaki, Roshi. From 1990 to 1999, he lived at the Mt. Baldy Zen Center

where he completed his traditional monastic training. In 1999, Kigen was given the title of Osho (Zen teacher) by Sasaki Roshi and appointed as Vice-abbot of the Rinzai-ji temple in Los Angeles. In 2012, Kigen Osho was invited to come to live in Vienna, Austria, as the resident priest at the Bodhidharma Zendo. There he teaches Zen meditation and offers lectures on the philosophy and practice of Rinzai Zen Buddhism. The particular style of Zen which he studies includes a unique oral tradition based on the philosophy of the 2nd century CE Indian philosopher, Nāgārjuna. Since becoming a Zen teacher, Kigen Osho has given numerous lectures at the University of Southern California and Cerritos College in Los Angeles, and has lectured and taught courses on Zen Buddhism at the University of Vienna. In 2016, he was a lecturer at the *International Symposium on the Philosophy of Nature*, sponsored by the Association for Comparative Philosophy and Interdisciplinary Education (KoPhil) at the University of Vienna. His lecture was published in *Philosophy of Nature in Cross-Cultural Dimensions*, a journal of lectures compiled by KoPhil. Kigen Osho has also written a number of online essays that seek to interpret the philosophy of Nāgārjuna and Zen in terms that are conversant with the Western physical sciences.

Massimiliano Sassoli de Bianchi received the Ph.D. degree in physics from the Federal Institute of Technology in Lausanne (EPFL) in 1995, with a study on temporal processes in quantum mechanics. His current research activities are focused on the foundations of physical theories, quantum mechanics, consciousness studies and quantum cognition. He carries forward interests in the field of inner research (self-research), promoting a multi-dimensional view of human evolution. He has written essays, popular science books, children's stories, and has published numerous research articles in international journals. He is the editor of the Italian journal *AutoRicerca* and currently the director of the *Laboratorio di Autoricerca di Base* (LAB), in Lugano, Switzerland. He is also a research fellow at the *Center Leo Apostel for Interdisciplinary Studies* (CLEA), at the Vrije

Universiteit Brussel (VUB), in Belgium. For more information, please refer to the author's personal website: *www.massimilianosassolidebianchi.ch*.

Valéry Schneider is Born in art, in Paris. Backgrounds: information & communication, law, MBA. Experiences: nearly 50 years of curiosity and personal points of view; 25 years in advertising and semiology; 4 kids. Photographer, working and experimenting plain aluminum processing since 2012. For more information, please refer to the author's websites: *https://everydetout.com*, *https://valeryschneiderbestregards.com.*

THE SECRET OF LIFE

A dialogue

October-December 2018

DIEDERIK: Nobody ever promised that things would be easy, and they are not. Nobody ever promised that suffering would not be intrinsically part of life, including part of your life, and it is.

Nobody ever promised differently, namely that each time again problems would arise, some hard ones, maybe some terribly hard ones, and some less hard ones, and that is how it is.

Nobody ever promised that it would be possible to solve even the minor ones of these problems at a first try, let stand the harder ones, and so it is.

Nobody ever promised that evil would not be lurking around, mostly even in those places where it can best hide its nature, and so it is.

The above short description is a good characterization of life in depth and we know why it is, because we, as human beings, have awaken to it in consciousness.

This is its nature because life is the moment to moment irreversible choice and constant fight against the spontaneous regression to 'just being', which on the local level of a human body we call death.

Every breath, every piece of food, every step, every smile, every embrace, every sprinkle of love, compassion, collaboration, construction, creation, are little parts of this constant fight against 'just being', or local death, the content of the second law of thermodynamics, and on a deeper physics level the separation of matter from anti-matter in time.

As little individual humans we are humble participants in this great endeavor of life, this great enterprise of struggle and fight, this deep endurance of suffering, this never-ending attempting of solving problems, failing and trying again, and sometimes succeeding in a local and modest victory.

The deep secret of life is that if you pursue a noble goal all the characteristics of life described above become the substance of meaning, which is the food of the human mind.

WILLIAM: Ah, an interesting point of view. It seems in much concert with the views of Jordan Peterson.[1] What this view describes might be called the "Way of the Hero."

Unfortunately, to my mind, this overemphasizes the "life principle" (i.e., male principle, i.e., order) and sets it up in an adversarial relationship with "death" (i.e., "chaos", i.e., "the feminine principle").

It describes the ultimate meaning of life as being gained from struggle and conquest over challenges/death rather than from the discovery of the innate harmony between these opposites.

DIEDERIK: I do not mean it metaphorically, but quite literally, physically, biologically and psychologically. It is also the condition of life for plants, animals and bacteria, but they are (almost) unaware of it, while for humans comes additionally the condition to be awaken to it in consciousness.

But it has a physical base, namely the second law of thermodynamics at the scale of classical physics, and the existence of matter (without the presence of anti-matter, which would annihilate matter into pure light, which is 'just being') at the deeper scale of quantum theory.

[1] From Wikipedia: *Jordan B. Peterson* is a Canadian professor of psychology at the University of Toronto, a practicing clinical psychologist, and public intellectual. He recently wrote the book "12 Rules for Life: An Antidote to Chaos" (Penguin Random House, 2018), providing life advice through essays on abstract ethical principles, psychology, mythology, religion, and personal anecdotes.

Of course, you are right William, it is about life, and how human beings participate in it. This does not exclude that human minds might also participate in still other realms of being than the realm of being which is life.

WILLIAM: It seems to me that one should not mention the 2nd law without also mentioning its corresponding (yet often overlooked) opposite: that the universe brings about greater complexity whenever circumstances allow for it.

Plant a healthy seed in fertile ground, and it will grow. Add a proton to an atom, and electrons will be attracted to it. It seems to me that the biggest problem we face as conscious beings is that we do not fully trust in this principle at the human level and so tend to seek disproportionate and unnecessary effort and/or attachment to particular states or levels of complexity and base our person validity upon the success or failure to do so. Thus, is born the hero (and villain) while the Sage avoids both extremes.

DIEDERIK: What you call 'opposites' are not opposites, William, in the realm where life happens, and in the realm where human bodies are part of life. The human mind, like I mentioned already, can explore other realms. But also, when an electron forms a hydrogen atom with a proton, this can only take place in the peaceful realm that was created by separating matter from anti-matter.

Of course, there is not yet an understanding how this could happen within physics; my personal view on this issue – without claiming that I have completely understood – is that it is linked to the coming into existence of past and future, i.e., the asymmetric nature of time (anti-matter moving backwards in time, hence being fundamentally separated from matter).

But 'opposite' is not a good way to look at these local domains of peace. It has taken a very drastic struggle and fight to bring them into locally stable states.

WILLIAM: Hmm, I don't understand what you mean when you write that what I refer to as "opposites" are not so "in the realm

where life happens, and in the realm where human bodies are part of life."

Autopoiesis in all its forms is simply the ability for some interaction to be able to express itself via any number of contrasting (i.e., opposite) alternatives. That is, a protozoan evolves the ability (over generations) to be able to move to the right or the left as a means for survival.

We are able to objectify stars and quantum principles because in being able to do so, it has allowed us to survive to the present. In non-autopoietic interactions (inanimate macro, atomic, and quantum), this capacity is lacking. I would suggest that all of the "drama" (i.e., very drastic struggle) that we generally apply to the phenomena of life or to the power of micro-level interactions, or even to the separation of matter and antimatter, are nothing but (can be nothing but!) taking place in/as an utterly and fundamentally "peaceful realm".

To put it poetically; the awesome power of every burning sun throughout the incomprehensibly large Cosmos does so in the perfect silence of space. The same is true for every human endeavor.

MASSIMILIANO: "Plant a healthy seed in fertile ground, and it will grow." Yes, but only because the ground is fertile, and because it is not too dry, or too wet, and it has not been previously colonized by other plants, which being older and stronger will take the sun light away from the newborn, possibly impeding its grow, etc.

Universe certainly can bring about new forms of complexity with apparent no effort, but only when the right circumstances are there to allow this to happen, when the right nourishment is in place, and we humans, becoming aware of that, we can precisely create those circumstances that would not arise spontaneously (with sufficient probability) without our contribution: circumstances more favorable to the creation of what we consider to be more meaningful, more valuable, according to what we are able to feel very deeply within ourselves.

Maybe that all this would happen anyway, in the very long run. Think about personal evolution, one can choose to do nothing and just say "I will just evolve at the rhythm of all of humanity, or of the rest of the cosmos, why should I struggle to produce, say, an acceleration at the personal level? Why for instance should I struggle to sit in meditation every day?"

Well, maybe because there is no guarantee that I can conquer what I feel has intrinsic value without some personal effort, that there is a risk that what can possibly come into existence, might as well never come into existence, and if it is something beautiful, that would be, in a sense, a pity.

WILLIAM: Yes, Massimiliano, all that you mention about the history of soil or the intervention of other plants or humans are all included in the law that "the universe brings about greater complexity whenever circumstances allow for it."

That is, there is no "universal principle" apart from all the constituents of the universe. I have not suggested that accomplishments are not important, but that to view them as a Heroic Quest is actually counterproductive to their accomplishment. That is to say, a great scientist (athlete, or artist…) will do great science despite his/her ego and not because of it. A star has no need to make sound in order to shine with unimaginable power.

VALÉRY: I think the dynamics you both stress (struggling for life and easy growth) are very true and indeed complementary in balance. But I think also that we should be aware of how much the "controlling/fighting against" force is emphasized and (over?)-valued in our culture and education.

Taking control, ordering… we have always been told to do so. On the contrary, the "easy and spontaneous" dynamics is mostly undervalued... if not highly tinted by guilt. When we stop struggling, answers and guidance often appear in a completely unexpected way... just right in time to fulfill our needs. And despite of the negative connotation of "surrender", it might merely be the unavoidable path to abundance...

By the way, quite a lot of artists I know are functioning this way. Pushed and pulled by a greater "urge" than will. Inspiration rarely comes out from will and struggling. It is an "offering." But on the other hand, it doesn't mean artists have low ego... on the contrary.

DIEDERIK: I think the words 'opposite' and 'balance' are wrongly chosen to indicate both aspects of life, because there is no symmetry. Life is intrinsically not in balance, and actually it is because 'being is in balance' that 'life is not in balance'.

It is the spontaneous tendency of reality to strive towards balance, a characteristic of 'being', which is the big obstacle to life, and the ally of the second law of thermodynamics. Life is characterized by constantly seeking unbalance, and then, because life is also construction and creation, cheating the spontaneous balance seeking of 'being', by creating little provisional domains of stability (where, locally, the illusion of balance can be fostered, but it is an illusion).

These provisional little domains of stability are right away again used to explore new states of unbalance, like stepping stones, and these stepping stones "are" actually the ancient old instruction mechanisms of life (and before what we usually call 'life', already of 'matter', so I consider matter in the absence of anti-matter the starting phase of life as we know it).

Light, because of a photon being its anti-particle, is 'pure being'. It is because matter and life are fundamentally 'states of unbalance' that a constant struggle and fighting is necessary. Of course, in the small local regions of stability, having been used as stepping stones in the ancient history of matter-life endeavor, the illusion of balance can exist, certainly so for the human mind, which has all types of features that characterize its own substance.

By the way, I do speak here all the time of humans mainly as their bodies, and we are also only certain that it is the body which dies, we do not know what happens to the mind. In the one extreme hypothesis, that the human mind only visits the human body, it is well possible that the human mind escapes this

struggle, and intrinsically is part of another realm of reality, where 'being' and not 'life' would be the default state.

It is also because life is this asymmetric state of affairs, stepping towards construction and creation, that it is intrinsically irreversible. It has chosen (for matter, against anti-matter, for unbalance, against balance), hence cannot ever go back, because going back would result in destroying all the intermediate stepping stones of local illusionary regions of peace and balance.

The human life, i.e., the life of a human body, in fairly healthy state, is such an intermediate region of illusionary peace and balance. But the peace between different nations is also such a local stepping stone region. One can easily recognize all this by a simple experiment and see the fundamental asymmetry.

Suppose ten nations live in peace with each other. It is enough that one starts a war, and all the others will be pushed out of their state of peace. The contrary is not true. Suppose that ten nations are at war amongst each other, and one of them decides to behave peacefully. This does not affect at all the other nine, on the contrary, that one nation will be forced into war again, or otherwise be conquered by some of the others.

This illustrates very well how 'peace' "is" an unstable state, while war is not, war is a stable state (stable means, make a little change and the state returns back to its original, like for a pendulum; unstable means, make a little change and no return is possible any longer, like for a pencil on its point; so peace is like the pencil on its point, war is like the pendulum).

Now, a question that needs to be answered is: if war is stable and peace unstable, why is there not just 'war all the time'? (War is the strongest state as compared to peace, the so-called attractor state). And here the irreversibility of the trajectory of life reveals itself. Although war is the stable state, it will destroy older already locally illusionary stabilities, e.g., it will kill the bodies of the human beings, and these bodies where such local stabilities.

Hence, it is because matter-life engaged in an irreversible path of struggle that the only survival possible is to always fight again

and again for local regions of provisional stability, otherwise everything is lost.

Hence, people know (for this reason, because they know in their guts what life is) that there is only one possible choice, to work and struggle for peace amongst nations, although this is a fragile and unstable state. It is also because of the deep nature of the whole enterprise of matter-life, that no other choice is possible than to keep on struggling and fighting for ever further stepping stones of local stabilities.

VALÉRY: Diederik, speaking about sense of balance and stability, the biological dynamics (inner ear) is pretty different than the balance/status quo/neutralization, obtained through opposite, counterbalancing/struggling forces in physics.

DIEDERIK: The balance system in the inner ear is a very good illustration of the overall asymmetric path of life and humans on it, Valéry, it is very much at the right place that you bring it up, because I was going to do it myself.

That human walks upright, is one of these stepping stones moving towards instability. And the mechanism in the inner ear indeed creates the local region of illusionary stability by means of a negative feedback mechanism. By the way, engineers can do the same, and even better now, when you look at the moving robots by Boston Dynamics. But a human standing up straight is in essence an unstable state, like the pencil standing on its point, and not like the pendulum, which is in essence a stable state. It is in essence an unstable state, locally stabilized into a small region of stability by means of the inner ear negative feedback mechanism.

The walking upright by humans also shows us an advantage fundamentally explored by the intrinsic instability, and we call it freedom. Instabilities indeed are states where little forces can make them collapse into very different states, this is actually even the definition of instability.

Consider a pendulum as the archetype of balance and stability, every little force applied to it will make it spontaneously move

back to its original state of equilibrium. There is almost no freedom involved in this archetype, and one could state for the sake of clarity 'no freedom at all, because of pure balance'.

On the contrary, states of fundamental disequilibrium, like the pencil standing on its point, and like humans walking upright, open up a vast set of potentialities of collapse towards disaster – the falling – of which however a very few ones are brilliant choices ahead in the 'stepping stone struggle path' towards further and new seeking of local instabilities.

Freedom, freedom of movement, and the now often voiced freedom of speech, is linked intrinsically with the irreversible asymmetric path of struggle of humans, it is, by the way, at each instant a choice between good and evil; also evil is always again offering itself as a possibility, and the choice for good is difficult, full of obstacles, away from balance, exploring the freedom of unbalance.

It is actually this jump that humans made, this new stepping stone jump, towards a new unbalance, the walking straight, which also distinguishes human from other living entities on the surface of planet earth. Most of the others having remained waiting too long in the region of local stability of 'crawling, walking on four paws' and even 'not moving at all in space, like plants'.

One can right away see the enormous potential the new step of walking straight gave humans in terms of choices, with good being always a small subset only of them, and evil being the majority, and definitely those that will result when no intentional struggle is made.

The actual state of affairs of nations possessing nuclear weapons and one button where the thumb of the boss (president) of each one of these nations can just push on and destroy all of humanity is a new phase of ultimate unbalance and disequilibrium and an intrinsic example of the characteristic of the human path.

Each moment of time, each second of our clocks, it takes an effort and a conscious intent to make the good choice and 'not push this button'. We all know that this is highly risky business, like walking on a small ridge between abysses.

So, actually, due to physics, finding the very ancient energy that was shielded away in the times that matter separated from anti-matter, hence in the all beginning days of the journey of matter-life, and the capacity to unleash it again found by the team of scientists in Los Alamos at the end of the second world war, is an enormous dramatic episode in the history of the path of humanity, the asymmetric irreversible path of unbalance. And, to show how dramatic it is, we should not forget that it came about as a consequence of the collection of constant choices for pure evil that were made by the Nazis at that time in the history of humans' path.

VALÉRY: Diederik, it is interesting that you assimilate the intrinsic instability (the pencil on its point) to choice, and therefore to freedom. I suppose we could argue something slightly different: that the pendulum is the representation of choice, with two extremities of the movement (good and evil).

We could also assume that pendulum and pencil on its point are both as perfect in balance (or as perfect in unbalance), but of different nature […]. Therefore, I am not so sure that stability or instability are criteria of choice and freedom. I suppose that your core idea was mainly focused on the concept of "perfection" that you attributed to pendulum and stability?

DIEDERIK: No Valéry, the pendulum and the pencil on its point are the archetypes of 'stability' and 'instability', respectively.

You can take an elementary physics course, and that is how stability and instability are defined in its essence. Let me write it out here: (i) a state is a state of 'stable equilibrium' if and only if whenever a (small or other) disturbing force brings it into movement, it spontaneously regresses to the original state (spontaneously, meaning, without the need of any mechanism); (ii) a state is a state of 'unstable equilibrium (disequilibrium)' if and only if whenever a (small or other) disturbing force brings it into movement, it moves spontaneously further away from the original state (for the pencil we would say that 'it falls').

This is the uncontested physics definition of stable equilibrium and unstable equilibrium (I called it disequilibrium, but actually the name 'unstable equilibrium' is more correct).

VALÉRY: Diederik, my intention was absolutely not to challenge the definition of equilibrium in physics! I simply expressed my doubt that such a definition would suit to the 'life equilibrium' analogy... or at least would suit it completely. It seems to me highly reductive. And thank you for the elementary physics course…

DIEDERIK: You are right of course that a physics definition does not have to necessarily apply to other parts of reality, but the definition is quite independent of whether the entities it refers to are physical entities or biological entities, or cultural entities, so it definitely applies to reality whenever the notion of 'state' applies.

Physicists were the firsts to formulate it so sharply, but it is also applied in other domains similarly, at least by scientists who attempt to make models. Also in economics, for example, the instability of the stock market is studied in this way. It is also actually the reason why top-down economic models will never work well, because they do not consider the intrinsic nature of matter-life.

Liberalism is much more compatible with this intrinsic nature as compared to a top-down model such as Marxism, for example. Of course, when liberalism falls into the trap of corporate capitalism, it also starts to deviate strongly from this intrinsic nature of matter-life.

Again – just to avoid misinterpretations of what I wrote about economic models above – the stepping stone path is one of seeking always, again and again, local regions of rest and stability, to be used as a new step to climb further on the path in struggle. This means that socialism, like it is inspired from Marxism, can very well function as such a local stable equilibrium region, and it has done so in the twentieth century without doubt.

Honestly, I personally had hoped it would be able to do this for much longer, till the crucial and very risky and dangerous

instability about nuclear war would have been overcome – and this can only happen when the nations unite into a bigger whole, the only mechanism able to express a local sphere of peace on the whole earth is the mechanism which was able to do so inside the single nations, one province of a nation will not go to war with another province, that is the local stable state of peace we should attempt on the whole earth urgently; it is for me the reason to be pro-European – but sadly enough the first decades of this century seem to indicate differently.

This means that humans will have to walk for quite some more time on this most dangerous ridge between abysses, with the thumbs of the bosses (the presidents) that can make the wrong move. It is the worst what could happen, and it has been defined in the first decades of this new millennium: humans have failed in a very important choice for globalization.

VALÉRY: Again, I do not intend to say that the sharp definition of equilibrium in physics can't be used to model/represent other reality theaters. Simply, I still think it does not express their full reality and mostly because it is a balance between polarities. I find the biological example of the inner ear interesting because it is a "floating type equilibrium," as a cork floating on a wavy sea. Of course, in physics this is probably not considered under the prism of equilibrium.

DIEDERIK: It is an archetype of a locally fabricated region of equilibrium Valéry, its mechanism is fully understood, which is also the reason that it can be realized now for robots, look at the robots fabricated by Boston Dynamics. The idea is very simple, 'each time you start falling, bring about a force to counteract this falling, and do this on a fine enough time scale'.

It is, by the way, only one of the mechanisms in which such local equilibria, giving rise to little islands of rest and balance, can be realized. In human society, not being robbed when you walk on the street, was realized in a rather different way, namely robbers will be attempted to be caught, punished, etc., hence a general realm will be created where 'robbing' is not an advice anybody

would give to a good friend. Why? Because we all know that if you become a robber, you will get a miserable life.

Many aspects of morality are actually mechanisms aimed at creating such local equilibria, as a stepping stone on the path of matter-life. There is an enormous range of possibilities to create such little islands of rest and peace, but that does not change that fact that the intrinsic nature of humans' path is not one of 'being for a long time' on such a local platform. The reason is that the local platform cannot substitute for the 'being', which humans have left behind the moment matter separated from anti-matter. That is why I have also – more as a challenge – used the wording: 'illusion of stability and peace'.

Now, let me specify more, such that a certain type of misunderstanding will not come into existence. If I say that the mechanism of equilibrium of humans is fully understood, this is probably not completely true. When it is realized in a robot – in a more efficient way than for humans even – the analogy is the one of the camera obscura: a camera also realizes what the human's eye does (even in a more performant way, as we do not have zoom lenses in our eyes). But because of the human body being biological (and probably even much more complicated than just biological), there is not one mechanism which is not entangled with almost everything else in a human. This means that also the equilibrium in the middle ear is of course a much more complicated mechanism, and probably even not localized entirely in the middle ear.

VALÉRY: Diederik, that is what I meant by equilibrium of two natures: one for which one force counteract another (your example of Boston Dynamics, or of the pendulum); and one which globalizes the process, like for human equilibrium: one stable (stabilized) unity, surrounded/floating in a constant environment bath.

By the way, it is quite amazing how in equilibrium exercises we can take support with the hand on floating air. We have the ability to materialize, to make our perception of air become solid as a wall. Robot will probably never have this information processing (or information creation?) ability.

DIEDERIK: I have probably not been able to explain well enough Valéry, because there is a misunderstanding still. The pendulum is one type of equilibrium, it is the stable one. The pencil on its point is the other one, it is the unstable one.

What Boston Dynamics does is to locally stabilize the unstable equilibrium of the pencil type, because that is what robots need to be able to do, at least those walking on two and not on four arts. However, the nature of the unstable equilibrium does not change by locally stabilizing it by means of feedback mechanisms that counteract moment after moment the falling.

The stable pendulum type of equilibrium is actually a dull type of state, not very much involved in the matter-life dynamics and evolution (I call it 'dull' to make my point, from the viewpoint of 'being' it is not dull of course, because it is the default state).

The unstable type of equilibrium of the pencil on its point, is the one that plays the crucial role in the matter-life dynamics and evolution, even if for reasons of control (to be able to take a break, to have a rest, "pour reculer et mieux sauter") locally mechanisms come into being which make it locally stable for a while.

When I add that the situation of humans is usually much more complex still, it is because I do not want to give the impression that I reduce a human being to what Boston Dynamics manages to do with a robot. But if you see the fantastic jumps and acrobatics of the Olympic Games, this extra complexity of humans does not play the main role in the local equilibria, all of intrinsic unstable nature, that you see performed there by humans.

We admire the skills that are shown to us in these sports, because humans know in their guts that the deep characteristics of matter-life dynamics and evolution is challenged and shown there. By the way, and this is not so well known, but we have investigated this in our group in depth, quantum superposition is actually a probabilistic version of the unstable state of equilibrium, i.e., the pencil on its point.

When 'uncontrollable fluctuations' are allowed to exist on the interaction of a measuring apparatus with the entity to be

measured, the unstable state (the pencil on its point) transforms into a superposition state.

VALÉRY: I have probably not been able to explain well enough as well, Diederik. We are not speaking about the same thing and the same definitions.

MASSIMILIANO: A great exchange. Diederik, the last sentence you wrote shouldn't be: "When 'uncontrollable fluctuations' are allowed to exist on the interaction of a measuring apparatus with the entity to be measured, the unstable state (the pencil on its point) describes a superposition state, which these fluctuations/disturbances will ultimately collapse into one of the stable (with respect to those fluctuations) outcome states, of the pendulum kind"?

WILLIAM: Diederik, why would you say that "life is intrinsically not in balance"? To maintain life, an organism must maintain a certain level of homeostasis, i.e., a dynamic state of equilibrium between its inner and outer environs. Clearly, this is an expression of balance. Of course, this type of balance can only be identified as being expressed over time (we can't just look at a photo of a person and determine if that person is still alive). What is "seeking balance"?

Life merely changes through connecting inside and out via some discrete set of alternatives. The evolution of alternative ways to interact within an entity's inner and outer limits is what accounts for survival. Fundamentally there is no seeking, no striving, no struggle, and exploration. These are not physical manifestations, only mental projections of our own experience of ego onto other expressions of reality.

For the living system, there are only choices between alternatives. The living system, by maintaining homeostasis, merely expresses a higher order of complexity, one that precisely follows the patterns shared by all lower orders. Although, I would agree that the question of whether or not some aspects of consciousness can continue on after the death of the body is still open.

However, the question of irreversibility is not only a characteristic of autopoietic systems. All systems higher than the micro-level exhibit the same irreversibility. As to the question of the relationship between matter and antimatter, that question is settled during or soon after the big Bang. After that, the point is moot, as all systems adopt the matter-as-opposed-to-antimatter character.

I also question your analogy of war as a stable state and peace as unstable. This can be proven simply by asking whether or not those who are contemplating beginning a war consider the option of whether or not it will be beneficial or detrimental to their country to wage war. If there is the slightest reflection on this question (and when could it not be considered) then peace exists as a force for stability.

If this is true, then to label the Nazi invasions as "pure evil" is erroneous. Pure evil does not exist, and neither does "pure goodness" (all must kill to survive).

Also, I don't agree with suggesting that a pencil tipped onto its point as something analogous to a superposition. Isn't this assuming that the Many-Worlds interpretation is true? Pencils and the tables they are balanced on, are expression of stabilized (i.e., collapsed) wave-functions that do not exhibit the characteristics that define quantum systems.

To wit, if we did not have any form of detection to determine where the falling pencil landed, would it give any proof that it in any way physically went in more directions than one (as is evident in the double-slit experiment)? I think not.

MASSIMILIANO: William, when you consider a pencil on its tip, you have to think about the situation as follows: placing it on the tip is like creating a measurement process, whose outcomes are the different possible spatial directions along which the pencil can fall. All these directions are only potential when the pencil is placed on its tip, in a state of unstable equilibrium.

Such state has an initial symmetry, which is broken as soon as one of the fluctuations present in the environment, at whatever level,

will become effective. So, you can describe this state of affair (even mathematically) as a state which is a genuine superposition of a number of states having a well-defined spatial direction. Only one of them will be actualized in the end, and before that, they are all present, not as actualities, but as potentialities.

The quantum collapse thus describes a symmetry breaking (in fact, more generally, a weighted symmetry breaking): it is really 'the actual that breaks the symmetry of the potential'. The fact that the pencil on its tip can be described in a quantum mechanical way, means two things: (1) that being quantum is first of all a structural aspect of how certain entities behave in relation to certain measurement contexts; (2) that there are different typologies of quantum entities.

The pencil is a spatial entity, you can describe it as always being 'in space', whereas for instance this is not the case of an electron. Well, in a certain way this could also not be the case for the pencil, but its non-spatiality is then much less evident to highlight, for many reasons (for instance, because of its too infinitesimal de Broglie wavelength).

So, in fact the contrary is true: the fact that a pencil can be described quantum mechanically shows that, in a sense, the many-worlds interpretation has little chance to be true, precisely because it is clear to everybody, in the example of the pencil, that we do not need to introduce parallel words to explain what happens when its unstable equilibrium is broken by the fluctuations present in its environment.

By the way, with Diederik we wrote a dialogue-paper some time ago, confronting our approach to that of the many-worlds interpretation.[2] I remember that at some point we used the example of a die rolling on a table, pointing to the unlikeliness of thinking of the experimental situation in terms of a many-tables reality… and the fact that the reality of a rolling dice, or of a falling pencil,

[2] Diederik Aerts and Massimiliano Sassoli de Bianchi, "Many-Measurements or Many-Worlds? A Dialogue," Foundations of Science 20 (2015), pp. 399-427, doi: 10.1007/s10699-014-9382-y; arXiv:1406.0620 [quant-ph].

previously in equilibrium, is in fact much richer than that described by its collapsed states.

This richness is precisely that contained in the potentiality of a superposition state, which is a state that, as Diederik would maybe also say, following what he wrote above, describes a situation of much greater freedom of exploration, allowing to actualize a much vaster spectrum of possibilities.

DIEDERIK: William, when I make it into a strong point to describe matter-life as a stepping stone trajectory of mainly intrinsically unstable states, which for each step of the ladder are locally attempted to be stable (for a while, as a rest pause, as a "reculer pour mieux sauter"), I do this to challenge the more common view of 'life as a being in balance'. So, I do not mean to claim that what I put forward is the common view, or that is generally accepted.

I think it is important however to strongly emphasize the aspects of what I have argued, because I believe that the more common view of 'life is a balance state' leads, in my opinion, to very erroneous and even dangerous attitudes and decisions, particularly at the point where human civilization has now arrived.

Of course, one can focus on the local stabilities, and the balances that can be reached within these small local realms, but if one neglects altogether the bigger historical view that I put forward, that is dangerous (and I repeat, I on purpose put a focus on the unstable aspects of this historical trajectory to challenge the more common view – it is important, I think, that I acknowledge this meta-attitude that I take on purpose, like an attempt to wake up the 'balance view' from its danger).

It is like walking on a ridge between two abysses and loosing attention for them, the danger is then very real to fall into one of them. So, I mean all this very literally, almost on an engineering level. By the way, as long as one walks on the ridge, one is engaged literally also in an exercise of balance. But the aim is to get off the ridge and at least into the valley where the two abysses are no longer lurking constantly. The valley is a real local place of momentary rest and relieve.

Massimiliano, in his more detailed account above, of such a local situation, shows very well that on this stepping stone path of intrinsic unbalance (and as a consequence, freedom of choices), there is another aspect that I did not bring up, and that is 'context'. The path of matter-life is not only an irreversible stepping stone path accompanied by a dynamics of instability with local momentary stabilities, but it is also a path of constantly changing contexts.

The instabilities or local stabilities are defined with respect to these contexts and are hence not absolute. A pencil on its tip is in an unstable state with respect to the gravitational field. If we consider it in a space ship, it would be the direction of acceleration of the space-ship which would define the space-direction the pencil has to be in, for it being on its tip.

With a complicated acceleration changing directions when moving, this state would change with the context – we can experience this in an accelerating car, not forgetting that taking turns is a form of acceleration. When there is really a wild driver some people will feel the states of the local equilibrium system in their mid-ears affected in a crucial way by these changing contexts of acceleration and become car-sick.

Of course, matter and the whole of the material universe, has reached a huge local stability, at least that is how it seems to us, because we are tempted to consider the material universe as the whole of reality. We do not yet have a good physical theory similar to the big-bang one which can explain the lack of anti-matter in our material universe, well, what I write is even a pleonasm, an explanation of the lack of anti-matter in our universe, would be the 'missing explanation of the bare existence of our material universe'.

The best that physicists have come up with is a 'symmetry breaking' somewhere in the early universe consisting then still mainly of radiation. It is possible of course that this is what happened, and it would even fit in the mechanism that Massimiliano pictures above. The collapse out of superposition between matter and anti-matter would have been the one towards matter, and that is why we are with this material universe. It would also still be

compatible with the stepping stone trajectory, the material universe "also" being on a local stability collapsed to in an early stage after the big-bang.

Personally, I think that a lot more must have happened, because there is this not understood connection between 'matter moving forward in time' and 'anti-matter moving backwards in time', explored technically in the Feynman diagram version of quantum electrodynamics. But many with me believe that there is something much deeper not yet understood involved there.

Hence, again I personally think we touch at the mere nature of time itself in this respect, and our bodies, consisting of matter within a local realm of the material universe, is a much more narrow and local state than usually considered (in my opinion).

Human engineering guided by scientific knowledge of going always deeper into this structure (what happens in CERN and other such places), I am also tempted to see this as part of this stepping stone evolution and dynamics, and not as something outside of it.

But again, one should also not forget that all this is for the human body as a material entity. I do not know whether the human mind as a conscious cognitive entity must be situated in all this. I do not think that the human mind escapes the fundamental structure of the trajectory, but that is only a guess – and also a consequence of how we are studying cognition now within the domain of investigation called 'quantum cognition',[3] but what is definitely not clear is 'what are the contexts with respect to the human mind that gravity (and time and space), for example, play with respect to the human body'.

WILLIAM: Diederik, thanks for your clarification. I actually think that our views are quite in concert to a substantial degree. If I may offer a small criticism, it would be on your choice of terms. In the

[3] From Wikipedia: "*Quantum cognition* is an emerging field which applies the mathematical formalism of quantum theory to model cognitive phenomena such as information processing by the human brain, language, decision making, human memory, concepts and conceptual reasoning, human judgment, and perception."

lexicon used by my teacher, "balance" was used as a universal: without balance nothing could exist (or cease to exist).

We use the terms "complete" and "incomplete" to describe the concepts you seem to be presenting. In a nutshell, according to what I was taught, the only two fundamental expressions possible are unity and polarity (i.e., diversity) and time can be understood as the unending oscillation between these two states.

What's interesting is that inherent in the cycle between unity and polarity is a sub-cycle whereby the polarities overlap; they are neither fully unified nor fully polarized. This can be understood as the incomplete state.

Take for example the polar opposites of black and white. In their unified state, they create a complete expression of grey. However, during the course of the progression from black and white to grey, there is an initial place of overlap where grey is being created and expanded (or contracted) due to the interaction between black and white. This initial grey area is unique because it has the unique quality to share in the qualities of both its "parents" (black and white). It is unique in that it creates a subjective experience (grey) surrounded by a bifurcated surrounding (the remaining black and white). This is a fundamental model for the incomplete state that I mentioned above.

So, it is that we unify opposites via every new connection we make, which sets us up for the next expression of polarity... which will be different from the first expression. The pattern progresses thusly: black/white to grey to white/black to grey... to black/white... etc.

So, in terms of the pencil on its point... At the point where it is at rest on its point, because it is an expression of macro-level matter, it is already incomplete in a larger sense... it is undergoing the process of its own creation (in some factory) and its destruction (via any number of heartless pencil sharpeners).

We can now map onto that larger given cycle the more local cycles of e.g., being on its point or resting on the table. But given that the pencil is simultaneously involved in its own larger-scale journey, the local problem becomes simple: pencil on point can

be understood either as an expression of complete unity or complete polarity (both are actually true), what is common to both is that while the pencil is falling it is in a (local) incomplete state of polarity (i.e., that state in-between pencil on point and pencil on table) that is compelled to find the next complete state (pencil resting on table), which can again be understood as either a complete unity or complete polarity.

I think that what I've laid out above sounds a lot like your stepping stone idea and seems to be very similar to your ideas about balance and imbalance. One more thing, as I've mentioned in other threads, I believe the universe follows the same simple pattern outlined above: diversity to unification that leads to a "switched" i.e., changed, expression of diversity.

This suggests our universe of matter continues to expand (diversifies) into a state of perfect homogeneous diffusion, which is the same thing (when looked at from the negative direction) as a state of perfect concentration: this would be the big bang for the next universe, but this would be an antimatter universe (unity to black/white to unity to white/black). Are we on the same page? In my essay "Telos and Complexity", I go into all this in a bit more detail.[4]

Massimiliano, thanks for the clarification. As I wrote to Diederik, perhaps we are not so far apart in our views. However, if everything can essentially be understood as a quantum wave-function (which I agree with), well, that's just like multiplying everything by 1... beyond the fact that it's important to know that it can be done, it doesn't tell us too much about why a 2 is a 2, and why is it different from 3, or 4? In other words, it doesn't tell what the hell are we counting! ;-)

It seems necessary to clarify exactly why there are differences between various phenomena and how these differences account for what we observe. You mention that there are different

[4] Kigen William Ekeson, "Telos and Complexity," February 24, 2017, 10 pages; submitted to the FQXi FORUM: Wandering Towards a Goal Essay Contest (2016-2017); *https://fqxi.org/community/forum/topic/2790*. See also this volume, page 141.

typologies of quantum entities. As you probably know, I wrote that there are discrete orders of complexity that can be modeled in a way that describes the differences we observe between micro-level (both massless and massive), macro-level, and autopoietic systems. Perhaps we are coming closer in our ideas (although I'm limited only to philosophical explanations).

I assume you would agree that in the case of a pencil (or any other macro-level system) it's important to recognize the distinction between a superposition occurring on the deterministic level as opposed to those happening on the probabilistic level. How would you explain that distinction(s)?

DIEDERIK: I think we do not really agree on this William, and there is no harm in this. In fact, and I should perhaps have stated this in a more pronounced way, in the view that I put forward there is a crucial difference between on the one hand 'being' and on the other hand 'matter-life and its trajectory'.

'Being' is of course the more fundamental substance of reality, perhaps even reality in its pure essence. Light is being, but matter and life are not, they are more particular states of being, and that is why 'balance' is not a good – and I would say even an erroneous – characterization of them.

I have said little about 'being', but actually I suppose that your view, which you also attempt to apply to matter-life and its particular trajectory, most probably applies well to 'being' (I think we would find agreement in this sense if our discussion would have been about 'being' and not about 'matter-life and its trajectory').

Your inspiration comes from an Eastern view, and it does not amaze me that the East was not able to see the 'particularity' of the matter-life trajectory, hence has always tried to apply very general features – which would be applicable to 'being' – also to the much more particular matter-life trajectory. That works more or less, because there are these local stabilities where matter-life and its trajectory resemble being, somewhat like 'rest and meditation' can resemble death, but it is only resemblance not equality, and considering it as equality is an error.

That Western science was able to look deeper is also understandable in this case, there are other examples of this. The Western method turned out to just be more powerful here than the Eastern method. Let me give you another similar example to explain what I mean.

Before Copernicus the earth, its skies and heavens where considered as not particular, but as the whole – in the Bible it is said that three heavens where created, so there was already some lurking thought foreseeing Copernicus. But the planets being heavenly Godlike creatures, and many other aspects of pre-Copernicus views (West and East, there was not yet a great difference then) were putting earth, seas and heavens on equal footing of symmetric importance.

Copernicus, adding the much later developments of the identification of the huge material universe, turned planet earth into a tiny little, but, more importantly, particular entity, and now we know, one of the many similar planets spread out over the material universe.

Geology of earth became a tiny particular science, not more general than history. But, for example, chemistry, which in the times of the Greeks looked perhaps much more particular as compared to earth, seas and heavens, turned out to be a really global and general subject – we have no doubt that we will find the same chemistry millions of light years away from us on one of the other particular planets (not the same chemical substances, but the same chemistry governing these substances, we will also find there).

So, our disagreement is linked to me at looking at matter-life and its trajectory as a much more particular phenomenon than the reality of ‘being’. Within the realm of our material universe, which I also see as much more particular than it usually is looked at, ‘light’ is the substance of ‘being’. That is also why its behavior is to ‘atypical’ when looked upon from the particularity of the matter-life trajectory.

The famous and really not understood constancy of the speed of light in any moving reference frame, this very paradoxical idea,

historically leading to Einstein's theory of relativity, well, in my opinion one should turn it upside down. 'Light' is 'being', and time-space are the particular entities coming only into existence together with the particularity of the matter-life trajectory.

That light behaves so paradoxically with respect to the time-space realm, also that should be turned upside down, it is the time-space realm in its particularity which behaves in such a way that, when the particular measurement of the speed of light is carried out, always the same value is encountered.

Now, is light then the ultimate state of being? Probably even not, because physics has proceeded further meanwhile. Even there some particularity is at place, light is the closets form of 'being' in the realm where the matter-life trajectory unfolds. A photon is its own anti-particle, which actually means that the matter versus anti-matter separation has not taken place for light, i.e., for photons.

But a photon has a spin equal to 1, which in my opinion shows that it is not yet the deepest appearance of being: it is spinning. And indeed, descending into the kernel of atoms, quarks and gluons show up, and their anti-particles. So, there is a deeper realm to be looked at which will make photons and light also a particularity.

We do not know sufficiently about this deeper realm, except, for example, that it obeys a symmetry which is SU(3) (instead of SU(2), being the symmetry obeyed in the realm where photons and matter are).[5] It can be calculated that if one wants to find out in which type of space this deeper realm thrives, one comes to a space of 8 dimensions instead of the 3 dimensions of our space. This is most probably the reason why quarks are never seen, although their existence is revealed indirectly in many ways.

MASSIMILIANO: William, I don't think we can speak of a superposition occurring 'on a deterministic level', as opposed to a superposition occurring 'on the probabilistic level'. A

[5] From Wikipedia: In mathematics, the *special unitary group* of degree n, denoted SU(n), is the Lie group of n×n unitary matrices with determinant 1.

superposition state is always defined in relation to a context. More precisely, in relation to a so-called 'measurement context', where the individual states forming the superposition are precisely the outcome states.

This means that a superposition state will always be associated with an indeterministic context: precisely that context relative to which the superposition state is such. Apart from that, what I think it is important to consider, and let me say that many physicists are not so much aware of that, is that there is no fundamental distinction between quantum and non-quantum (like classical) entities. What one can more properly ask, and try to determine, is if a given property (or more generally, a given observable), in relation to a given entity, is or is not a quantum property/observable.

Position for instance, if you consider the position of the (center of mass of the) pencil on the table, is a classical observable. But that same position becomes a quantum observable if you consider it in relation to a single electron. You can say (but this is only a way to describe things) that to have a spatial position is a non-ordinary property for an electron, whereas it is an ordinary property for the pencil. Here I mean ordinary in the sense of something that would be usually actually possessed, in a stable way, by a given entity.

Quantum aspects of an electron can be revealed by asking the electron an experimental question about its position. The electron usually does not possess a position, so, when forced to answer such question, it will have to create one (a spatial state) out of a non-spatial state, which is the superposition state here.

Again, it can do so by 'breaking the symmetry of the potential', by actualizing an outcome. This process is by definition indeterministic, because sensitive to the tiniest possible fluctuations, at different possible levels of deepness.

Macro-entities, like a pencil, will never reveal an indeterministic behavior if you only ask them ordinary questions, in relation to their states. But when you ask a pencil a question that is not ordinary for it, its behavior will become indeterministic.

Imagine for instance asking the pencil a question about its lefthandedness, and that the way to ask the question is to take the pencil with your hands and try to break it into two parts. And if the longer fragment remains in your left hand, this means that the pencil's answer about the lefthandedness question was affirmative. This "lefthandedness property" of the pencil is not a classical property. Asking a pencil about its lefthandedness will produce a quantum-like behavior, genuinely indeterministic.

So, is a pencil classical or quantum (or intermediate)? This is not the right question. The right question is: which properties of the pencil are classical, quantum, or intermediate? And the same we can ask for an electron.

For instance, having a rest mass of approximately 9 times 10 to the minus 31 kg is definitely a classical property of an electron. Having a one-half spin is also a classical property. In the human psychological realm, we have the same situation. Sometimes we are asked questions about which we do not have a predetermined answer, as we have not made yet our mind about them. These are quantum (or quantum-like) interrogative contexts for us, relative to which we find ourselves in a superposition state.

Other questions are instead classical, deterministic, because we know beforehand the answer. No elements of potentiality will be involved in the answering process.

WILLIAM: Diederik, my views are indeed based on Eastern notions of reality. Actually, I doubt whether we are on the same page about any idea of being as "the more fundamental substance of reality." In my view, neither being nor non-being can be said to be fundamental.

I tend to think the Eastern approaches to be superior to Western views in that they generally include the phenomena of subjectivity (e.g., an observer) as integral to their models, while the West has no way to do so. That is, beingness is understood as a relative condition (and who could argue with that?).

I think you misunderstand some aspects of the Eastern approach to reality if you suggest that a meditative state (i.e., Samadhi) and

actual death of the body are seen in all ways equal. Quite simply, the Eastern view can be understood as fractalesque. Like a fractal it's all about a single and recurring pattern (outlined in my last response to you) expressed at different co-dependent levels. The birth and death of the body is simply a larger (longer in terms of time) expression, while moment by moment interactions are shorter expressions of the exact same pattern.

It seems to me that the Western approach is like taking a car apart and putting it back together… but no matter how well one can do this, one will never find the driver… although it's a fantastic way to learn how to care for and/or build cars!

I also consider light to be fundamental in some sense, but merely because it manifests as the simplest known expression of the pattern of being/non-being. "What is spin?" It seems to me that spin is just the reality of that pattern manifesting in/as its simplest forms. Adopting this view suggests a simple, clear, and beautiful explanation for the constancy of the speed of measured light, quantum superposition, as well as quantum entanglement without the need for extra dimensions. The Western approach is completely unable to provide any such explanation.

Massimiliano, I would argue that even a pencil has no spatial position. All "entities" are relative expressions manifesting as part of some bifurcated context. Local expressions of particular systems are all identical except in the degree of complexity that each local system expresses (or has the capacity to express). That is, from the subjective perspective of a pencil, it has no such qualities as length, hardness, or location. It merely has the capacity to locally exhibit a relatively complex expression (i.e., higher order) of more fundamental expressions of the same pattern of action.

In both cases, an even more complex observer (e.g., a human) is necessary to locate and "create" either an electron or a pencil, or any qualities of either. Likewise, the left-handedness of a broken pencil is completely an extrinsic quality projected upon a pencil (or now 2 pencils) by a human, relative to a previous projected quality of pencil wholeness.

The questions of whether a pencil expresses classical, quantum, or intermediate properties seems to me to be completely unnecessary, except when analyzing variations in complexity. In terms of the system that gives rise to the broken pencils, all levels are equally at work (although not all systems need to exhibit the same level of complexity, e.g., the electron). However, it is the human observer that creates the "longer" and "shorter" entities of the broken pencil. No such distinctions intrinsically exist for the broken pencil.

What seems to me to be of sole import is how differing systems of complexity interact with each other. In the case of breaking a pencil, unless the pencil is of perfect consistency (impossible) then (hypothetically) the point of its breaking can be deterministically predicted. Isn't that correct? If that is so, although the human observer is necessary to "create" both a left-handed pencil as well as a collapsed electron-wave, it doesn't depend solely upon the non-physical act of mere observation to collapse the superposition as is the case with observing an electron going through a double-slit.

The reason why that is the case seems to me to be the most important topic and must be linked to the operation of the phenomena of subjectivity that manifests in all systems (except light) or consciousness (as expressed by humans).

So, when I emphasize the difference between observing determinate and indeterminate interactions, I'm emphasizing it with respect to the processes necessary for a human measurement to take place. It seems to be that if there is no understanding for how subjectivity is integral to how any particular system can become localized, then no explanation for the double-slit can be made. Does your model include any explanation for subjectivity?

MASSIMILIANO: William, in the experiment where you brake the pencil, there are fluctuations that you cannot usually control. You have to consider here that they are part of the protocol for measuring the lefthandedness of the pencil. If you change the protocol in order to eliminate these fluctuations, then you will test a different property of the pencil-system.

In a paper I published some years ago,[6] I introduced the distinction between "lefthandedness of type 1" and "lefthandedness of type 2". The type 1 is when you do not try to control the fluctuations, the type 2 is when you do.

Imagine you ask a person a question. You might be interested in receiving a spontaneous answer from the person, and this would correspond to a "type 1 question;" or you might instead be interested in having the person produce the answer that you want, and this would correspond to a "type 2 question."

Physics' measurements are type 1 questions: we ask the question, but we do not want to influence the answer. The only kind of influence we accept to produce is that of forcing the system to provide an answer, because it might not do so spontaneously.

So, no, you cannot predict in advance the answer to the lefthandedness (of type 1) question/test, because when such question is answered in a practical way, the fluctuations are part of the game and cannot be eliminated. Note that this genuine unpredictability is not in conflict with the view that reality might well be deterministic as a whole.

Now, as regards subjectivity, it enters modern physics by means of contextuality and the fact that certain properties can be actualized only by certain experimental contexts. So, it is not really 'subjectivity' but 'contextuality'.

An electron will usually be in a non-spatial state, hence, the property "having a well-defined position" will not be one of its stable properties. But it can be actualized when interacting with a spatial entity, like a detection screen (this is where the subject enters the game, when taking the decision to bring about a specific experimental context). Now, unless it will form a bound state with such system, this actualization of a well-defined position will not last. In other words, the property of "having a well-defined position" will only be actualized in an ephemeral way.

[6] Massimiliano Sassoli de Bianchi, "God May Not Play Dice, But Human Observers Surely Do," Foundations of Science 20 (2015), pp. 77-105; doi: 10.1007/s10699-014-9352-4; arXiv:1208.0674 [quant-ph].

But there are properties which are instead intrinsic, they are always actual for all observers, that is, in all contexts that are useful to consider in relation to that entity. In a sense, they are non-contextual. Like the rest mass of the electron, which I mentioned in my previous comment.

Now, for sure, you can always consider that even what we consider to be intrinsic properties, that are permanently actual for a given entity, they will one day cease to be such. This will generally be the case when the entity carrying those intrinsic properties is destroyed, or spontaneously disintegrates (a free neutron has a mean lifetime of approximately 14 minutes, before decaying, say, into a proton, an electron and an antineutrino). Because such intrinsic properties are part of the very definition of the entity.

So, entities can be created and destroyed, but once created, and for as long as they continue to exist, they will have properties that define their identity, which are stably actual (which means that we can predict with certainty the outcome of their test, without the need of performing them), whereas other properties, the non-intrinsic ones, will generally "dance" in-between actuality and potentiality, depending on the contexts they will interact with. In a sense, they are relational properties.

But not all properties are of this kind. In other words, everything changes, when we consider the global picture, but there are many islands of stability. When in physics one describes a physical system, one places oneself within a specific (many times idealized) island of stability, which corresponds to the permanence of the intrinsic properties of the system one is describing and studying.

One could even go as far as saying that the different physical theories, like classical physics, quantum mechanics, relativity, thermodynamics… they all take into consideration some specific "regions of stability" of our everchanging reality. Heisenberg used to speak in terms of "closed theories," perfectly accurate within their domain of validity, which in a sense is also a domain of stability.

With Diederik, we introduced a related notion of "multiplex realism",[7] where our focus is more on the "closed theaters" where some entities can be represented but not others (or not entirely), and the fact that our "parochial" spatiotemporal theater has its origin in the very specific evolutionary path we followed so far on the crust of our small planet.

DIEDERIK: I do not mean to say that I consider the Western view superior to the Eastern William, there are many Western views and also many Eastern ones, I suppose, hence even this classification in West and East is kind of superficial. What I meant to say is that quite often we can understand now 'where and why some more ancient human views, whether better classified as Western or Eastern, were wrong', mainly because we can see the limitations that brought them to this erroneous aspect of their views.

I remember having read about harsh discussions about heliocentrism and geocentrism already going on during the old Greek times, i.e., with the Pre-Socratic, and one of the very daring hypotheses that created some kind of ban on the scientists-philosophers proposing it, was the idea that 'the moon would actually be also just made of rock'. We can understand now, because of the lack of the view we now have post-Copernicus, that such an idea must have been very heretic then, because the moon was in the realm of the heavens, and hence could not be 'just made of rock'.

At this actual state of knowledge of humanity, and again, quite independent of whether one is Western or Eastern inspired in one's views, we have learned some things that might warn us against older views where one had not yet learned these things. I give some examples. We now know that whatever view is developed, it will always be a kind of idealization. Hence, views that pretend to be the absolute truth, we better be skeptical towards them, again independently of whether they are Western or Eastern inspired.

[7] Diederik Aerts and Massimiliano Sassoli de Bianchi "Do spins have directions?" Soft Computing 21 (2017), pp. 1483-1504; doi: 10.1007/s00500-015-1913-0; arXiv:1501.00693 [quant-ph].

Another thing we learned, progress is possible and happening with respect to the knowledge that humans have about reality and its nature – we know now that the moon is made of rock (but we also know that 'rock' is not an absolute truth type of knowledge).

Another important insight, in my opinion, that has not been digested yet by all sciences and/or views, whether Western inspired or Eastern inspired, is that 'aspects of a specific view can be really wrong', and it should be added to this that 'aspects and/or parts that have been claimed and defended by the most brilliant minds representing some of the views, can be just wrong also'.

Physics is typically a science that has come to terms with this insight already, every physicist will acknowledge Albert Einstein to be one of the most brilliant minds, but that does not avoid that he could have been just bluntly wrong in some of his views. For other sciences and views, it seems still to be the case that one needs to accept the whole packet or otherwise one is not even allowed to pertain to the students of a specific view.

This phenomenon of 'the whole package or nothing' happens as well in Western as in Eastern inspired views, and is, in my opinion, a symptom of immaturity of the view. So, it is a very healthy step, I think, to allow the thought that 'aha, there they have seen things very deeply and sharply, but there, they really missed it, and were wrong', whether it is about a person (try to apply it to Heidegger, for example), or whether it is applied to a view in itself.

WILLIAM: Massimiliano, I didn't suggest that the prediction for lefthandedness should be practical… only that it was hypothetically possible if enough micro-measurements could be made during the process of breaking. But either way, this is not so important w.r.t. the main point I am trying to make. Breaking a pencil into two parts doesn't seem to me to be at all analogous to the puzzling phenomena observed as the wave-function collapse exemplified in the double-slit experiment. That is, the observed transition from a wave-like existence to a particle-like existence using nothing but the phenomenon of observation doesn't seem to have an analogous effect (or explanation) in your examples.

We break a pencil in half, yes, there will be all kinds of both deterministic and indeterministic interactions involved in the process. We cannot say that the process is fundamentally indeterministic or deterministic because both are necessary. We can't break pencils in half merely by observing them which would be the analogous situation if we were to correctly model the double-slit experiment.

You write that: "certain properties can be actualized only by certain experimental contexts." It seems to me that ALL properties of all entities are always entirely the expression of some context. An entity cannot ultimately be distinguished from the context that gives rise to it; they are intrinsically codependent. That is, it seems to me that entities do not "confront" different contexts, they ARE context.

It is ultimately differing contexts that express entities that interact (entity/context). One main way to distinguish differing classes of entity/contexts is to separate them into those that do exhibit true subjective character from those that do not. That is, I believe true "subjectivity" to be an emergent characteristic of some entity/context that we usually understand as a classical level entity (or, e.g., an electron that exhibits particle-like behavior).

The only defining quality necessary for the emergence of such true subjective qualities is the relative complexity of the entity/context that is expressed. In light of this, it doesn't appear to me that your examples address the reason why an electron suddenly exhibits particle-like behavior (i.e., true subjective qualities) when hitting the detection screen or anything else. That is, it seems to me that whenever the entity/context of a freely moving electron is absorbed into an entity/context expressing a macro-level subject (like a rock), the two entity/contexts (that give rise to both rock and electron wave) will combine and the function of the electron-wave is transformed into a corresponding higher order expression within the rock.

Of course, an electron within a rock (or a pencil) will still exhibit micro-level behavior, but new behavioral limits have been imposed upon the electron that impart a particle-like subjectivity relative to its freely moving condition. It is my view that the exact

same principle is in effect during observation in the double-slit experiment.

We, as higher-order entity/contexts have the capacity to transform lower-complexity systems into our own human entity/contexts. So, merely observing something for us is to transform it (a wave-front going through two slits) into our own, human version of reality i.e., particle-like behavior. The double-slit experiment shows us that this in not mere intellectualization that happens in our heads, but is a phenomenon as physical as when an electron hits and is absorbed into a rock.

You write: "But there are properties which are instead intrinsic, they are always actual for all observers, that is, in all contexts that are useful to consider in relation to that entity." This is also problematic for me. That is, we can only measure the rest mass of an electron, we cannot measure its mass in a freely moving condition without collapsing its wave-like state. So, to say that the mass of an electron is x for anyone who measures it is no different from all agreeing on the weight of paperclip.

The point is, that the context/entity of either an electron or a paperclip does not have any intrinsic quality called "weight." Weight is a subjective quality that can only be created and applied to something by human beings. Neither a rock nor an electron intrinsically expresses weight because their true weight cannot be limited only to their dynamic subjective expression (or lack thereof)… it is human beings that set those limits and artificially quantify them. Their subjective qualities cannot ultimately be separated from the entirety of their context/entity except as a matter of convenience for human beings. Therefore, their true weight (if such a term has any real meaning) would include the totality of the context within which they arise and eventually decay back into.

You write: "So, entities can be created and destroyed, but once created, and for as long as they continue to exist, they will have properties that define their identity, which are stably actual (which means that we can predict with certainty the outcome of their test, without the need of performing them), whereas other properties, the non-intrinsic ones, will generally "dance" in-

between actuality and potentiality, depending on the contexts they will interact with."

Again, this seems to me to point to an unclarity between the nature of entity-ness and true subjectivity. Isn't it more accurate to say that a photon-wave is an entity, but it doesn't exhibit subjective behavior because subjective behavior is a quality dictated by the relative complexity of the entity/context? That is, although a free neutron decays after 14 minutes, the entity/context that gave rise to it is essentially eternal, although it will combine with other context/entities and thereby undergo transformations of many kinds. In this sense, it seems to me that wave-like behavior/properties are just as intrinsic as classical ones when we are describing wave-like entity/contexts.

You write: "When in physics one describes a physical system, one places oneself within a specific (many times idealized) island of stability, which corresponds to the permanence of the intrinsic properties of the system one is describing and studying." My point is that we cannot insert ourselves as subjective "islands of stability" when conceptualizing systems that don't exhibit subjective characteristics and correctly conceptualize them as they interact with those that do.

It seems to me that the reason why we are having such a hard time explaining the double-slit experiment is because of two reasons: we conceptualize a wave-front as being a subjective entity rather than non-subjective one, and we don't believe that our own type of subjective behavior (i.e., consciousness) can directly interact and transform entity/contexts of lower complexity into a completely new level (our own).

Diederik, I wouldn't disagree with much of your last post, and of course, there are many eastern and western views that vary greatly. However, I think that it is safe (and correct) to surmise in the context of this discussion that the Western approach has largely been to study and analyze the external world (taking the "self" as a given), while the East has generally placed greater emphasis on understanding the nature of subjectivity (i.e., the inner world).

DIEDERIK: That is definitely one of the systematic differences between East and West William, which is also why both can learn from each other, and probably both also have had tendencies of exaggerating the importance of their vantage point, inner or outer.

MASSIMILIANO: William, breaking a pencil into two parts is analogous to the wave-function collapse in a double-slit experiment. But it is analogous only for some aspects of the process, and different of course for some others.

First of all, consider that quantum measurements are invasive: they dramatically change the state of the observed entity. The double-slit experiment is also invasive: it is not a mere experiment of passive "pure observation," during which the observed entity would be left undisturbed. Having to impact on a screen is something very perturbative, something comparable to the two hands breaking the pencil.

But please, consider that this was just an example inspired by our conversation, to be taken 'cum grano salis'. More sophisticated "quantum machines" examples can be constructed, and Diederik has been a true master in doing so, as from the eighties of the last century. These machines have a genuine quantum-like behavior, in the sense that they exhibit a 'quantum-like abstract structure', manifested in the way they respond to well-designed experiments (i.e., actions performed on them).

But of course, a pencil is a spatial entity (at least, for as long as it remains under the incessant influence of the decohering photonic bombardment present at the surface of our planet), whereas an electron in a 'quantum physics laboratory' is generally not. Consider however we are already able to execute double-slit experiments with very small "pencils" made of more than 800 atoms (formed in total by more than 5'000 neutrons, 5'000 protons and 5'000 electrons).

But let me comment on a point which is maybe one of the reasons of our "disagreement." What is a property? This is what we would need to clarify as from the beginning, if we do not want

our conversation to become a dialogue where we only apparently speak of the same thing.

Can we "attach" properties to physical entities? Well, probably the most general definition of a property is that "a property is a state of prediction". In the sense that a property is operationally defined by means of an experimental test. And if you can predict with certainty the successful outcome of the test (without the need to perform it!), then you can say that the entity in question possesses the property, that is, that the property is actual for that entity.

This is similar to Einstein-Podolsky-Rosen's celebrated reality criterion. So, you see, I do not need to perform an experimental test (which is by the way a special type of measurement, a yes-no measurement, with only two outcomes) to be able to 'attach' a property to an entity.

Now, since entities change their state with time, some of their properties will be actual at certain moments, other instead, will cease to be actual and become potential. When you consider all the properties that you can associate with an entity, that can be actualized in certain contexts (although many times only in a probabilistic way, that is, not with certainty), then all these properties will define the entity in question. In that sense, you can really say that a physical entity (but not only a physical one, the definition is more general and applies also to more abstract entities) is precisely that: an 'aggregate of properties'. And the 'state' of the entity is what specifies which of the properties are actual and which are potential in a given moment.

Some of these properties can be predicted to be actual all the time. And these are the intrinsic properties, defining the very identity of the entity. Note that, to come back to the previous example, you do not have to measure the mass of an electron to be able to say that the electron 'has' a given rest mass. You only need to be able to predict it with certainty. And since we can do so, this is why we can speak of the rest mass of an electron in a counterfactual way, without the need of measuring it.

Coming then to what you write, of course, we humans, because of our very specific place in the cosmic drama, manifesting in the

present historical period of our evolution with our three-dimensional macro-bodies, we certainly have considered designing and performing certain tests on certain entities, and not others. This, I can agree on that, means that there is an element of "subjectivity" on the properties we attach to the different entities.

But maybe the term 'subjectivity' is not so well chosen here, because even though the definitions of these properties might contain elements of conventionality, parochialism, etc., nevertheless they genuinely characterize an aspect of the entities they refer to. In that sense, they are not at all subjective: they capture part of the nature and reality of these entities.

With time, knowing more about our reality, physical and extra-physical, we will be able of course to improve our maps of reality. They are subjective, as they are maps that we humans are constructing with all our preconceived ideas and countless biases, but they are also objective, because we are drafting and improving them using data coming from all the answers reality kindly offers us, in response to all our experimental questions.

DIEDERIK: What I want to add to the above clear exposition about properties by Massimiliano, is that 'this is an issue not at all generally understood even in Western physics'.

Actually, and this is again meant to make very clear that a real new insight is taking place here, one can even claim that 'a property is attributed to an entity whenever no subjectivity at all is present'. Massimiliano, and also our colleague Sandro, have deeply been confronted with this insight, like me, because we all have been taught quantum physics in Geneva with Constantin Piron,[8] and he, as a student of Ernst Stueckelberg,[9] was the one

[8] From Wikipedia: *Constantin Piron* was a Belgian physicist who worked for most of his career in Switzerland. In 1963, he earned his doctor of science degree from the University of Lausanne, under the direction of Ernst Stueckelberg and Josef-Maria Jauch, with a thesis on quantum logic. He developed Jauch's methods (called the Geneva approach) for the foundations of quantum mechanics. Piron's Theorem (1964) is a famous representation theorem he derived for quantum lattices.

[9] From Wikipedia: *Ernst Carl Gerlach Stueckelberg* was a Swiss mathematician and physicist, regarded as one of the most eminent physicists of the 20th

bringing this insight explicitly to physics, although Einstein was its initiator in the EPR paper of 1935 (but not having understood it yet completely himself, when the paper was written).[10]

The example that our teacher Constantin Piron would give is the one of a 'strong car' (like a Volvo, for example). The strength of such a car is scientifically defined by crash tests with the car. Of course, if you would buy a Volvo, you definitely do not want that a crash test has been executed with the car that you buy. But, even so, while never a crash test has been done on that car, you know that it is a strong car, equipped with the strength tested by crash tests on other identical cars.

"This" is new knowledge brought systematically into the realm of human knowledge as a consequence of the systematics of the scientific experimental method. Of course, this method was already applied unconsciously by all our ancestors, and also by animals, to construct their view of the world. Hence, the subjectivity reigning when one 'lives an experience' is not at the root of the knowledge about the nature of reality, in a way it is usually imagined it is – that reality would exist while one experiences it. It is actually just the contrary, it is the systematic repeated experience over time and ensuing statistical knowledge of such experiencing that puts into working a construction mechanism, and it is this construction mechanism which is at the root of what we believe to be real (the nature of reality).

It is in depth erroneous to believe that a chair is real because one experiences it by sitting on it. It is indeed not because you can experience sitting on it, but, 'because you know that each time that you would attempt to sit on it, you would have this experience of sitting on it', that the chair is real.

century. Despite making key advances in theoretical physics, including the exchange particle model of fundamental forces, causal S-matrix theory, and the renormalization group, his idiosyncratic style and publication in minor journals led to his work being unrecognized until the mid-1990s.

[10] Albert Einstein, Boris Podolsky and Nathan Rosen, "Can Quantum-Mechanical Description of Physical Reality be Considered Complete?" Physical Review 47 (1935) pp. 777–780; doi:10.1103/PhysRev.47.777.

So, no need to sit on it again when this knowledge is used as the root of the reality of the chair. Of course, it is easy to sit on a chair without destroying it, and that is the reason of the confusion and belief that it is the subjectivity of experiencing the sitting in itself which is the root of reality. That is also why the example of the Volvo car explains so well, one cannot make a crash test with the car that you want to use and then drive with.

It is also because in experimentation with the micro-world the most common event is that the experiment destroys the entity one is experimenting with, this new insight came to the knowledge package of physicists in 1935. But it is of such a subtle nature that even in physics it is not generally understood and digested. Each time we move with our group into another scientific discipline (psychology, economics, finance, medicine), we see to our amusement that this insight is not at all understood, leading to deep philosophical but also practical errors.

It is easy to see that also Eastern views on the world have not grasped this insight – which is really not amazing if even all Western sciences except a part of quantum physicists – have not grasped it neither. Of course, also our students, Tomas, Jonito, Lester, Suzette, Lyn, as one of their first exercises, have to make the effort to go to the depth of this insight.

Former students also had to do this, which means that there is almost a concentric circle phenomenon making it spread out, starting from the 1935 EPR paper. It is by the way interesting to point out which was the aspect also not yet understood by Einstein: he believed that the notion of measurement 'that does not disturb the entity' was a crucial one, hence one can see that he had not fully grasped that the experience itself (i.e., the actual having it) is not necessary for the knowledge about the presence of an element of reality.

VALÉRY: I do not intend to bring more complexity into the topic but, defining reality by "experimental iterations," is not the only possible road to exploration. One of the most striking experiences is the one described by Giacometti. His work was about encapsulating an "absolute reality," which does not depend on

fluctuating actualizations of reality and "subjectivity" (in time, in matter, in functional context, in interrelation with us and the surrounding).

So, in a sense, he tried to capture the absolute objectivity of objects, isolated from our experience, surrounded by voids and frozen in time, and described them without weight and without contact points.

Maybe we could say that the only constant property is impermanence. But on the other hand, he expressed simultaneously the opposite: that there is a remaining constant floating (a reality "in suspension" above the common and acknowledged properties). Somehow, we might understand that as the foundations of surrealism, which, by first isolating each "thing," allows to reconstruct reality by allocating to each part another place, while preserving a global "recomposed" coherence. For example, in "L'Atelier d'Alberto Giacometti," by Jean Genêt (which is a very short and incredibly powerful read, that I highly recommend), you can read:[11]

« Ce garçon de chez Lipp qui s'immobilisait, penché sur moi, la bouche ouverte, sans aucun rapport avec le moment précédent, avec le moment suivant, la bouche ouverte, les yeux figés dans une immobilité absolue. Mais en même temps que les hommes, les objets subissaient une transformation, les tables, les chaises, les costumes, la rue, jusqu'aux arbres et aux paysages. Ce matin en me réveillant je vis ma serviette pour la première fois, cette serviette sans poids dans une immobilité jamais aperçue, et comme en suspens dans un effroyable silence. Elle n'avait plus aucun rapport avec la chaise sans fond ni avec la table dont les pieds ne reposaient plus sur le plancher, le touchaient à peine, il n'y avait plus aucun rapport entre les objets séparés par des incommensurables gouffres de vide ».

Ok, you might find that this is completely out of topic in a discussion about physics... but weren't poets the first to have the intuition of the existence of atoms, long before they were observable? Anyway, I – and my surrealist mind part :-) – find

[11] Jean Genet, *L'Atelier d'Alberto Giacometti*, 96 pages (Gallimard, 2007).

interesting to superpose Giacometti's perception with Massimiliano's definition of properties, which is an important prerequisite to explore reality, but also to explore the reductive awareness with which we explore our surrounding. And somehow, it loops with the starting point of the discussion on stability/instability of equilibrium...

MASSIMILIANO: thanks, Diederik, for this important historical contextualization. And yes, the Volvo example was one of the favorites of Constantin. Another one that remained engraved in my mind is his warning about the danger of confusing breakable chalks with broken chalks!

By the way, let me mention that when I was in Geneva, in the years 1990-91, I did not have the chance to meet Diederik, as he obtained his PhD ten years before, in 1981, if I'm correct. However, being daily in contact with Constantin during my stay at the physics' department, many times I heard his name pronounced by Constantin, always with great admiration. About the topic of the "elements of reality," as Einstein liked to call them, Constantin once wrote in one of his papers (the original is in French, this is my translation):

"At first sight, it seems that there would be a conceptual difficulty in attaching properties to the empty space, like for example affirming that it is almost Euclidean and that there is a field of gravitation. Indeed, how to verify such statements without having to introduce apparatuses, and in this case, we no longer have the vacuum. This apparent paradox has been solved par Dirk Aerts, thanks to a precise formulation of the notion of element of reality, together with a precise definition of the experimental projects. Indeed, according to Aerts, an experimental project is an experience, which we could certainly possibly execute, such that the positive outcome has been defined once for all. In full accordance with Einstein's definition, Aerts then claims that the system possesses an element of reality and that the property is actual, if we can affirm in advance that in case of execution of the corresponding project the positive answer is certain."

So, there are many names to be mentioned in this lineage of people who have reflected about the key notion of 'element of reality' in physics: Ernst Stueckelberg, Josef-Maria Jauch,[12] Constantin Piron, but Diederik Aerts has also to be mentioned among these names – last but not least! – as he was able to close the circle of this first historical phase of reflections on these important topics, and to start a new phase of reflections in which I have today the honor and privilege to participate.

WILLIAM: Massimiliano, yes, of course, the act of observation is perturbative. However, it is not the physical interaction with the detector screen that brings about particle-like behavior when it is observed, it is the non-physical act of observation that does so, as this is shown by the different distributions the particles take on the detection screen.

Regarding our ability to get similar effects using molecules, this simply indicates the fact that we are able to manipulate molecules into wave-like superpositions. This is nice, but doesn't seem to me to explain anything about the decoherence caused by observation.

I agree with you that when it comes to the meaning of the word 'property' we come to the crux of our discussion. To begin with, when you write that: "a property is a state of prediction," our views have already diverged. Why? Because all predictions are predicated upon a predictor. I'm approaching the matter in a way that casts aside ALL assumptions, all labels, all conceptualization… all need for predictions of any kind. So, if there are no predictors, what then becomes of the properties? This is an

[12] From Wikipedia: *Josef Maria Jauch* was a Swiss/American theoretical physicist. He studied mathematics and physics at ETH Zürich and in 1940 was an assistant to Wolfgang Pauli. In 1960 he accepted a professorship at the University of Geneva, where he became the director of the Institute of Theoretical Physics. He remained in that position until his death in 1974. His work focused on quantum scattering theory, the process of measurement in quantum mechanics, causality, irreversible phenomena, and gauge theories. His contribution to the axiomatization of quantum field theory is a mathematical model of rigor.

interesting question, one that is deeply tied to reality as it is experienced by human beings.

Take for example a fork. If all human beings (or, say, all life) were to vanish from the earth, leaving all the forks behind, any conception about the utility of forks as eating devices would disappear with them. That is, forks would no longer exist as forks because there is no such thing as forkness, apart from the beings able to use them as such. However, the fact remains that things are left behind that used to be understood as forks… so, what are they now?

Obviously, they still express something, but I hold that whatever that is, cannot be said to possess the property of forkness. Beyond that, and in exactly the same way, if all life on earth vanished, I would say that all the properties of an electron would likewise disappear.

Why? Because all such notions of fixed mass, spin, etc., are predicated upon comparisons with things that exhibit different properties. However, in order to do that, one must first draw a distinction between "this and that" i.e., the electron would first have to be observed (by something) as being separate from the world around it. This separation cannot be taken as a given.

Why? Because fundamentally, there is nothing except the one universe. Therefore, unless and until some limits are internally created and imposed from within this one universe by sentient beings, then undifferentiable oneness is its sole property.

However, even when limits ARE imposed (created from within) upon certain parts of the one universe, those limits are arbitrarily determined (even if everyone agrees to do it in the same way) and therefore are subjective interpretations. That is, as I tried to explain in my last post, just because we all know the mass of an electron in no way validates the property of massness. All it does is to offer a convenient way for us to use electrons (or the knowledge) in ways that will hopefully benefit our species.

The fact that the universe maintains itself in a particular configuration we call "an electron of mass x" has no meaning or importance, or specific distinction in the daily life of the universe

(or of an electron)… all properties become moot in light of the single shared reality we all share… just as the forks littering the now mammalless earth have lost all definition as forks.

Imagine, if you will, a snake. This snake's movements are peculiar in that it always forms the exact same size and shape curves as it slithers along. We could measure these curves and define their properties, we wouldn't even have to see the snake to know the specific size curve is being produced, but these measurements would only be valid when observing the snake in motion. If we were to pick up that snake, we can see that the curves appeared to us not as intrinsic properties of the snake, but only as a convenient observable constant that helped to understand how the snake moves.

That is, there is no such thing as snake's curves apart from observing them and divorcing (i.e., creating) them as being somehow distinct from the rest of the snake. The idea that these curves possess any permanent intrinsic properties apart from their larger context seems absurd.

Yes, the snake cannot move (as far as we know) except by forming these curves, but the curves have no autonomous reality apart from the useful construct we've created to describe the motion of the snake. The reality of the snake is not limited to units of curvyness, nor does any one of those unit curves have any independent reality or non-trivial property.

The same holds true with electrons. They are not fixated lumps of matter that are universes unto themselves. Electrons are in a constant state of dynamic renewal of their configuration, a renewal that I believe involves the entirety of the universe.

It seems to me that the same is true for everything else. Therefore, to say that an electron has this or that property or that what it is "is a summation of all its properties" will always leave out one key and indispensable ingredient… that they are a tiny expression of a shared whole from which it derives 100% of the capacity to exhibit any and all properties we might observe and label.

The same is true for any finite set of aggregate properties. You write: "some of these properties can be predicted to be actual all

the time. And these are the intrinsic properties, defining the very identity of the entity." Again, it seems as though you are still not letting go of the idea of an observer who makes conditional distinctions within a fundamentally unified system.

The universe is not a universe of properties, it is a universe of oneness wherein properties are conditionally expressed. I think this distinction is important because the former suggests a particulate nature (suggesting a mechanistic function) while the latter a holistic one.

When I refer to some entities as exhibiting subjectivity and others not, I am not referring only to human subjectivity. I am referring merely to a state of relative complexity exhibited by a particular type of sub-system functioning within the whole.

Perhaps it can be thought of like water. There are the atoms and molecules of water, and many of these molecules flow in currents. Some of these currents are powerful, others weak. Some of these currents are warm and others cold. Within these currents, eddies, swirls, and waves are formed. None of these elements can be fully described apart from the entire system, although the only way to have any chance of making practical use of them would be to attempt to do so.

Diederik, as I wrote earlier, I see no problem with positing an entity without subjectivity, but I think that is because I have my own definition for entities with and without subjective qualities. I also don't have a problem with attributing properties to non-subjective entities. However, I do disagree with the idea that these properties can in any way describe the true qualities of a system other than as provisional tools created by humans for human convenience.

It seems to me that all of the examples you've given are predicated on their being an observer to do things such as drive sturdy Volvos or to sit (or not sit) in chairs. Again, as I wrote to Massimiliano, what if all humans disappeared? What then would become of the property of chairness? Or strong or fragile cars? All Gone! No more chairs would ever be created, no more cars would ever be driven. The only thing that would remain would be the

underlying action that maintains the existing chairs and cars as well everything else in the universe. This action is not fast nor slow, strong or weak, nor old or young, it's not "this or that" because it necessarily would include and transcend all such trivial distinctions.

I wrote in my reply to Massimiliano my responses to general ideas about the term "property" and perhaps here I can respond by focusing on what I see as our unique capacity as subjective entities to conceptually bifurcate our surroundings. That is, I hold that it is the hallmark of autopoietic systems to have the capacity to generate alternative behaviors; to generate more than one inner response to an outer circumstance or vice versa.

The greater the number of alternatives open to a particular system, the greater its chance for survival. At the level of human beings, we are able to generate an unlimited number of alternatives, some of which are completely impossible, impractical, or conceptual, but that doesn't matter, as all of these are mere expansions on the capacity that has enabled our species to survive and thrive. What it has also done is allow us to perceive the universe and ourselves as an almost inconceivably complex system of "this and that" alternatives.

I would also go so far as to say that our capacity to impart limits (necessary for alternatives to be created) upon our inner and outer surroundings effectively imprisons us in a version of the universe of our own creation. However, in many ways we ARE creating our universe. That is, we really have in a sense created cars, and houses, and ideas, and numbers, and light, good, bad, and anything else we can conceptualize limits from within a universe where none of these things previously existed.

However, anything we have brought into being via our human endeavors are all precariously dependent upon a preeminent singular system that actually gives rise to everything we can observe (and also gives rise to us)… and will continue to BE the universe once all of us (and all of our creations) are gone.

Therefore, excuse me for saying it and I mean no disrespect, but the idea that knowledge is the equivalent of "being" seems to me

to be quite arrogant in that it assumes that we actually know what we are looking at, what we are measuring, what we are naming... we do not. All we can do is overlay concepts on something that is fundamentally beyond conception.

Suppose we are all "brains in vats" and all of our subjective content is fed into us. I certainly don't hold this view, but I believe it should be enough to give one pause before suggesting that knowledge is as important as you seem to be suggesting.

Now, you certainly don't have to take my word for how human consciousness evolved out of an increase in the capacity to generate alternatives for survival, but unless you have your own or some other means to explain it, you are taking human cognition as an intrinsic given… and I can see no proof of this being the case from observing the many systems that possess no capacity to do so. By the way, one of the winning essays in the 2017 FQXi contest was by Carlo Rovelli,[13] whose text had essentially the same conception of the importance of alternatives in biological systems.

DIEDERIK: That our knowledge about what is real relates to a construction from repeated equivalent experiences and the predictability of these specific experiences, without the need to experience them, does not put knowledge on a higher stance than it is customarily looked at William.

The insight is about 'the mechanism that is underlying this coming into being of this knowledge'. Actually, this mechanism is not only applying to specific situations, such as the one of the strong car, but also to all other imaginable entities and situations. It is such a primitive and foundational mechanism that we learn it very early in life, and afterwards keep it mostly unconscious, which is why we are not aware of the mechanism.

[13] From Wikipedia: *Carlo Rovelli* is an Italian theoretical physicist and writer who has worked in Italy, the United States and since 2000 in France. His work is mainly in the field of quantum gravity, where he is among the founders of the loop quantum gravity theory.

If you have the knowledge that the wall behind your body exists at this specific moment, then this is because you know that if you would have turned around, before living the moment you are now living, you would have experienced this wall. Now, you did not, because you did not turn around. But you know that 'if you would have turned around you would have'.

Actually, the existence of a 'conditional tense' in all human language is the historical root of when our ancestors started to integrate this knowledge about 'what is' into their language. Your speculations about consciousness are submitted to the same mechanism, nothing escapes it, but we forgot this.

You see, when you put forward hypothesis about consciousness and the human mind, you start from the knowledge that you have about an entity which we call a human body, and how this entity functions in human society, and an entity which is the human mind, and the specific way in which this human mind can behave, and consciousness. All this is submitted "first," before one can even start to speculate and put forward hypothesis about it, to this mechanism of predictability. We however forgot about it.

Let me give another aspect of it, the notion of free will. It's fundamental, because "only" if you believe that you could have made a different choice in your past it makes then sense to believe that the wall behind you exists without looking at it (that the car is strong without testing it for a crash test, and here it is even essential that one does not test it, for the wall you are allowed to look, but actually even looking at the wall will always disturb something about the wall, hence the real wall is pure in its existence – like the strong car – only if one does not experience it).

Even the model where we have a body, mind and consciousness, "has come about" as a consequence of this pre-scientific mechanism of how we conceive reality (construct reality). Even what we call 'inner experiences', they come about in the same way: we will see such an inner experience as a "real entity," if the mechanism fits it. That we locate inner experiences "inside" our mind and/or body, is also a consequence of the same mechanism of construction.

Crucial is always our belief in free will, namely "that we could have done something else, such that we would have experienced something else." There is another subtlety, and that is about 'creations'. Our free will hypothesis means that we could in our past have 'created things that we did not'. These missing creations are not part of reality. This is, by the way, one of the deep mistakes in the many-worlds view: they do not make a distinction between a discovery and a creation, and experience always consists of these two elements, a discovery part and a creation part.

It is only the discovery part that attributes to the building of reality. There is a very funny situation which confronts all this nicely, namely the phenomenon of 'the light in the refrigerator'. We all know that when we close the door of the refrigerator, the light goes out. However, if we would test this, we will always see the light on, right away when we open the refrigerator. It is because the 'light shifting from off to on by means of the opening of the door' is a 'creation aspect' of our experience, that 'the light is not part of the reality of the refrigerator, when the door is closed'. Like the painting that a painter could have made in his or her past are not part of his or her reality in this past. The discoveries that someone could have made in his or her past are however part of the realty of this person, in his or her past.

MASSIMILIANO: William, I observe that you write that "...it is not the physical interaction with the detector screen that brings about particle-like behavior when it is observed, it is the non-physical act of observation that does so, as this is shown by the different distributions the particles take on the detection screen." This, in my view, is not correct.

It is precisely the presence of the screen that brings about the particle behavior. Indeed, speaking for instance of an electron, it will always leave localized trace of impact on the detection screen. Then of course, by repeating many times the experiment with similarly prepared electrons, the accumulation of these impacts will start forming a fringe patter.

Here you can immediately see that neither a description of the electrons as waves, nor as particles, is able to fully explain what

happens. Indeed, if we use the wave model, we cannot understand how it is possible that localized impacts are left by them on the screen (as waves are extended objects), and if we use a particle model then we cannot explain the fringe interference pattern. The reality is that electrons are neither waves nor particles, but "something else".

What we know is how this "something else" behaves in some situations. Now, to know what "something is," is it sufficient to "know how it behaves"? Well, we could say that if we observe the behavior of an entity in a sufficiently wide spectrum of contexts, maybe we will not know the ultimate reality of that entity, but certainly we will start knowing a great deal about it.

You can argue that this is not the case because the properties we can deduct from these behaviors depend in turn on the contexts that have been considered in order to observe them in the first place. And that if these contexts would not be available anymore to be actualized, then also these behaviors will cease to exist. Yes and no, because what will remain is the propensity of the entity in question to behave in those specific ways in case those contexts would be again be brought into existence.

This propensity in behaving in certain ways in certain circumstances, which is something you can predict, is precisely what we mean by attributing certain properties to certain entities.

Now, it seems to me that there is a subtle point, leading to a possible "solipsistic-like kind of confusion," which is not sufficiently demarcated in what you say. Let me try to explain it by means of an example. Imagine that I kick a pole on the road. Because of Newton's third law, the pole will react by exerting on my foot an exact opposite force. The pole's behavior, you could say, mirrors my behavior, so I'm not really observing the properties of the pole with my kick, but only those of my 'subjective kick of it'.

Ok, but then imagine that instead of a pole I now kick a stone. In this case, the reaction I will receive on my foot will be different (as the stone, contrary to the pole, will be set into motion); so, whatever is "out there" (imagine I am blind), it is not something

always faithfully mirroring what I do, as different portions of reality do react to a same kick in different ways.

This becomes even more evident with some entities like a dog that I may also cross on the road, which if I kick might "kick back" by rightly biting my foot.

Now, if you are telling me that we humans are like dull blind guys trying to obtain a picture of what is out there by just randomly kicking around in all possible directions, hoping to be able to see something clearly in this way, I do certainly agree with you that this seems to be (in part at least) the case. The knowledge we have acquired so far is extremely limited, and the way we have tried so far to depict what is out there, by collecting data from all our "kicks" might well produce a completely misleading image of what the reality out there is really about.

But this is just because we are dealing with something very complex and multilayered, and that we are only apprentice scientists, who are moving our "first kicks" in the long path of our 'evolution in knowledge'.

Another important thing to say is the following. One thing is how we describe an entity, with our human language, using our specific human concepts, and another thing is what our language points to. A dog "biting who tries to kick it" is an objective property of most dogs, which is independent of how we describe it with our human language. It remains such, independently of the fact that people, say of a more advanced humanity, will have learned to respect animals to the point of never kicking a dog, in whatever circumstance.

Let me also add that we can (and typically do) also discover new properties by performing new experiments, more sophisticated kicks (e.g., strokes) that we were not able to conceive or implement before. The advent of quantum physics, for example, is entirely the consequence of the fact that we could perform new experiments with "old" entities and that the answers we obtained were totally unexpected.

The old answers remained (the reactions to the old kicks), they were not invalidated, but new answers had to be added, new

behaviors in new contexts, so we learned something new that we did not know before. This knowledge we have acquired is objective, although it is certainly not complete, and it might remain forever incomplete.

It is objective because reality is not just a mirror, it is much more than that. And yes, we have to be fully aware that the answers we receive depend (but only in part!) from the question we address. And as it is the case with people, some questions will be more revealing than others about who is truly standing in front of us. And certainly, you can also say, and I would agree, that 'asking questions and collecting answers' might well never provide enough data to obtain a complete "picture" about reality.

Fair enough, I also do not believe that scientific experimentation and theorization is the only way to go to learn all that can be possibly learned about reality. Other modalities are certainly valuable and necessary, which extend beyond what today is considered to be science. It is about promoting what is sometime called 'inner research', or 'self-research', or 'spiritual research', or 'contemplative practices', etc. But even with these additional approaches, there is no guarantee that one will of course learn all the possible (inner and outer) kicks one can give and receive back from reality.

A last point. In physics (but not only) when we speak of a system, we do so in an idealized way. The very notion of a system means that you have singled out a portion of reality, and by doing so, obviously, you have neglected, or simplified, the ways such a portion relates to the rest of reality. You might be tempted to say that defining a system is an arbitrary and conventional thing to do. I would say that it depends how you do this.

If you actually do so in a completely arbitrary way, then yes, of course. And certainly, even when you do so 'cum gran salis', you might not see always clearly what should be included in the definition/description of the system, in order to be able to consistently explain its behavior, i.e., for your explanations of the system to have some power.

So, there are certainly different ways to single out systems from the whole of reality. Sometimes it is convenient to talk about a single electron (for instance, passing through a double-slit apparatus), other times it is more convenient to talk about an entire electronic field in interaction with an electromagnetic field, to be able to account, say, for the creation and annihilation of electrons and for the existence of their antiparticles (positrons).

But this is the same as when we observe a landscape. Sometimes we want to describe a characteristic of the entire landscape, other times we are interested in describing an aspect of it that captures our attention. And of course, the process will also depend (but only in part!) on our personal choices and personal interests. Poincaré used to say that everybody will agree that 'reality is one', but that what is interesting (and difficult) to know is 'how it is one'…

WILLIAM: Massimiliano, yes, the electrons express both wave and particle properties. Also, no one could disagree that the electrons are made visible to us on the detector screen. However, isn't there a first collapse that happens when we observe one of them going through one of the slits (or not) before they hit the final detector screen? Isn't it this "either/or" detection at the slits that changes the shape of the pattern on the final detector screen from a wave-like pattern to a particle-like pattern of hits?

Is not this changing of the pattern on the detector screen when observation is present the primary mystery of the double-slit experiment? Yes, whenever the electron-wave hits the detector screen a mark will be left, but this is not as mysterious as what happens at the two slits.

You write: "what will remain is the propensity of the entity in question to behave in those specific ways in case those contexts would be again be brought into existence." To my mind, this is a circular argument. It's no different than saying; "purple is a real property of high frequency light because every time I look at something purple, it's still purple!"

But perhaps color is too simple of an example. What I think you are saying is something along the lines of: "although I will never

have the actual experience of seeing my ears, I can see their reflection in a mirror and they're the same every time that I look, so I really do know that I have ears and what they look like even though I will never actually see them." Is that a good analogy for your position?

As a response, I would say that what we know about any "thing" can only be an intricate set of extrinsically produced "yes/no/both/neither" alternatives relative to other "things" produced by (and therefore conditionally limited by) our conscious experience. All such types of perceptions are fundamentally extrinsic because they completely depend on the almost inconceivably intricate human interpretation of reality constantly being erected and expanded via the functioning of consciousness.

We know what ears are because we have the ability to contrast sight from hearing. We have the ability to contrast eyes from ears, head from feet, etc. So, in the example of our unseen ears, the only thing that is fundamentally going on with them is a series of interactions within a universe that expresses all interactions without distinction or bias. Therefore, all the interactions we can possibly have in order to objectify our ears, share the exact same ultimate limits (i.e., beginning and end) as any other interaction in the universe.

They are without "true" descriptive limits when cognized within their ultimate (i.e., intrinsic) context. In exactly the same way the properties of mass, spin, and/or atomic configuration allow us to give meaning to our experience of discretized phenomena that are nonetheless fundamentally without any of those relative properties apart from the human construct erected to organize them into a metric.

The reason I'm championing this extreme perspective is to emphasize the fact that there is an aspect to nature that is fundamentally indivisible. This unity is not merely a concept, it is an (maybe the only) intrinsic property of everything.

Please don't mistake my position. I do not deny the power of using predictions, or tools such as mass, spin, or ears in order to broaden our knowledge or better our human condition. I merely

suggest that when we endeavor to try to understand how it is that different classes of phenomena transition to each other, then we cannot stick only with the "language" of diversification that allowed our ancestors to prosper. We need to create (or identify) a metric that is common to all levels of interaction.

That is, it won't make any sense to try to describe what is happening in the double-slit experiment in terms of properties used to create animal species classifications in biology. Why? Because although there is a vague similarity between classifying microparticles and classifying animals, the units of measurement do not commute between the different systems involved in a way that's helpful; in fact, to hold on to one system or another is to transform that system into a stumbling block.

I have nothing but respect for the scientific method. However, I believe the measurement problem is unique because (to use your analogy) heretofore, we have indeed been like blind folks; kicking this way and that and comparing all the different properties of the things we have kicked. This is the usual way to gain scientific knowledge. However, the measurement problem forces us to take a step backwards (or forwards) from this method, a step we have never had to take before in science (although I believe it is explored through religious experience).

That is, we are forced to find a solution that includes an explanation for our own ability to kick in the first place!

That is, although mass (and ears) are indeed important emergent phenomena, how can mass be a fundamental unit in solving the measurement problem when consciousness is not divisible into units of mass? What I believe is necessary to solve the measurement problem is to first find a fully commuting metric that can serve as a kind of lowest common denominator(s) that can commute between all levels of interaction, including consciousness. Therefore, I emphasize the importance of negating those metrics that are clearly emergent and conditional only to specific levels.

Diederik, I disagree with your assertion that: "when you put forward hypothesis about consciousness and the human mind, you start from the knowledge that you have about an entity which

we call a human body, and how this entity functions in human society, and an entity which is the human mind, and the specific way in which this human mind can behave, and consciousness. All this is submitted 'first', before one can even start to speculate and put forward hypothesis about it, to this mechanism of predictability."

I suggest that nothing needs to be submitted to erect consciousness because the only fact any of us can be one hundred percent sure of is the fact that we are conscious. John Searle[14] states in a 2013 TED talk: "Where the very existence of consciousness is concerned, if it consciously seems to you that you are conscious, you are conscious. It's real and irreducible."

Thomas Nagel[15] goes into much greater detail in support of the same supposition in his seminal article, "What is it like to be a Bat?" What consciousness actually is, is still up for deliberation, but until good evidence supports some other notion, then I take as a given that the subjective experience of consciousness is itself the only evidence necessary to prove its reality... there is no construct we erect in order to establish it. Who or what would erect such a thing and why?

However, beyond the fact that our consciousness is irreducible as a life experience, I also hold that consciousness is an emergent phenomenon, and I have presented a way to clearly model how it manifests in ways that differ from non-conscious entities-contexts.

Concerning ideas about free-will, I think that perhaps you overconflate the importance of free will and hypothetical decisions with our ability to synthesize mental alternatives (in order to

[14] From Wikipedia: *John Rogers Searle* is an American philosopher, known for his contributions to the philosophy of language, philosophy of mind, and social philosophy. His notable concepts include the "Chinese room" argument against "strong" artificial intelligence.

[15] From Wikipedia: *Thomas Nagel* is an American philosopher. His main areas of philosophical interest are philosophy of mind, political philosophy and ethics. He is well known for his critique of material reductionist accounts of the mind, particularly in his 1974 essay: "What Is it Like to Be a Bat?" (1974). He argued against the neo-Darwinian view of the emergence of consciousness.

cognize the world). Whether the alternatives that help us shape our understanding of things pertain to some past option, or some present, future, or completely imaginary options, doesn't seem to me to necessarily affirm the principle of free will.

It seems to me that some serious work still needs to be done concerning notions of free-will. Standard understandings of free-will affirm that there is an entity = to mind that is "driving" the body forward in time. I find this idea ill-conceived in a lot of ways that I'm happy to try to explore in conversation, if you wanted to go there. By the way, thanks for all your replies… all very interesting to me!

VALÉRY: By the way, historically, "the starting point of consciousness knowledge," was the other way around. It started from conscious experiences and not from human body functioning/system process knowledge.

It was so before Descartes' assumption that only what is observable out of our senses (so to say, through outer mechanisms... microscope, telescope, etc.) is real. Pre-Cartesian societies were certainly much more advanced in "consciousness knowledge," as they didn't have this "apparatus obligation" and relied on convergence of individual complementary experiences.

The split between objectivity and subjectivity is merely a consequence of Descartes' postulate... for the best and for the worse. Cartesianism is a filter (like many others) through which we are observing reality. It's the idea that our senses are misleading us (the "mauvais genie" who is lying and joking at us, to mention Descartes "evil incarnation").

DIEDERIK: What I mean William, is that one should not be too certain about the view that of course is the one commonly held, that 'subjective experience' is the basis to build everything else on. This is a view which is believed to be so obviously true that it is always good to be suspicious of whether it is really true or not. And certainly, all theoretical hypotheses that afterwards are built and put forward about consciousness start from this view.

What I wanted to put forward is that certainly for these 'theoretical building hypotheses', there is already an underlying realistic (not subjective at all) starting point that founds them, namely the way you look at things, your body, your mind, and the mind having this 'subjective experience'. This view is 'not linked at all to a subjective experience', but to a statistically grown outer construction, containing an enormous number of steps away from the pure subjective experience.

To give you only one example of such a step: learn to make the difference between a dream and reality. It is by the way funny that Eastern philosophical views often later (much later, after thousands of statistical steps of constructing reality independent of subjective experience) make this additional statistical reality constructive step of blurring reality with dreams again.

All this is interesting, but it is wrong to believe that it is on a deeper level of consciousness than Pasteur detecting bacteria. Even if it is not on a deeper level, it might still be true of course.

MASSIMILIANO: You ask William: "…isn't there a first collapse that happens when we observe one of them going through one of the slits (or not) before they hit the final detector screen?" To this first question of yours, the answer is affirmative.

If you place an instrument to actualize a location for the particle in the region between the double screen and the detection screen, then indeed, such process can be described as a "first collapse." If the process is produced by a light source, this will not destroy the electron, which then will be able to subsequently hit the screen, producing a "second collapse."

Note that there is a well-known video on YouTube, which is part of the documentary "What the Bleep do we know!?",[16] that

[16] From Wikipedia: "What the Bleep Do We Know!?" is a 2004 American film that combines documentary-style interviews, computer-animated graphics, and a narrative that posits a spiritual connection between quantum physics and consciousness. The film has been described as an example of quantum mysticism, and has been criticized for both misrepresenting science and containing pseudoscience. While many of its interviewees and subjects

describes this possible prior observation in a completely wrong way, because the process is portrayed as a passive eye placed before the double-slit screen, and not after it. But it cannot be passive, and it cannot be placed before the double-slit screen. To see a correct description, the best text is still today Feynman's famous lectures on physics.[17]

Now, you also ask: "Isn't it this "either/or" detection at the slits that changes the shape of the pattern on the final detector screen from a wave-like pattern to a particle-like pattern of hits? Is not this changing of the pattern on the detector screen when observation is present the primary mystery of the double-slit experiment?" Well, yes and no.

No, because if you spatially localize the entity before it is detected by the final screen, but after it passed through the double screen, and you do so in order to determine the slits it has "passed through," then there will not be anymore 'interfering alternatives' for the entity reaching the screen, so the fringe pattern will disappear and you are then in the same situation of an experiment with a single fringe (with one slit there can still be interferences effects because of the phenomenon of diffraction, but this would be a different discussion). In other words, observing the particle before it reaches the screen is like creating a one-slit experiment situation.

On the other hand, indeed, what is important to observe – and Feynman explains this well – is that you cannot lower the intensity of the light source in order to observe the electrons passing through the slits without disturbing them, because of the quantized aspect of light (photons of finite energy). So, there is really no possibilities to bring back the description to a classical one.

By the way, in the open access paper "On the Conceptuality Interpretation of Quantum and Relativity Theories," published in Foundations of Science,[18] we attentively analyze, in Section 2,

are professional scientists in the fields of physics, chemistry, and engineering, several have noted that the film quotes them out of context.

[17] The books are freely accessible at: *www.feynmanlectures.caltech.edu*.

[18] Diederik Aerts, Massimiliano Sassoli de Bianchi, Sandro Sozzo and Tomas Veloz, "On the Conceptuality Interpretation of Quantum and Relativity

the double-slit experiment, trying to highlight what we think is the true mystery it reveals: that the electron passing through the double-slit screen, ultimately leaving traces on the detection screen, is a non-spatial entity, thus more like an abstract concept interacting with a meaning-sensitive structure than an object moving in space, or a wave propagating in space.

You also write that to state that: "purple is a real property of high frequency light because every time I look at something purple, it's still purple!" would be a circular argument. It certainly is the way you wrote it, I would say on purpose in a circular (tautological) way. But you can rewrite it as: "purple is a real property of high frequency light because I can predict with certainty that every time I look to a high frequency light source I will perceive its radiation as what we humans call a purple color."

Now, we know that the perception of colors can also vary depending on contexts, so, by studying high frequency electromagnetic radiation, we can discover that the "purple property" might not be exactly an intrinsic property of high frequency light. There is also the problem that humans are not all reliable as measuring instruments, etc., but to some extent, you can certainly speak of the purple color as a property of high frequency electromagnetic radiation. And this example is quite interesting, as it reveals that there is really a 'construction of reality', which indeed depends on the measuring instruments we use to characterize it.

The purple property, you might say, and rightly so, is a very parochial, humancentric viewpoint on electromagnetic high frequency radiation (e.h.f.r.). So, trying to characterize e.h.f.r. using properties of this kind might not be the best thing to do, to capture the true nature of e.h.f.r.

But the example also reveals that there is a 'meeting' between two structures: what in the example is the more objective structure of e.h.f.r., namely that related to the oscillating fields, the transverse waves with a range of frequencies we call 'high frequency' and the related energies, etc., and the structure that has to do with our eye-

Theories," Foundations of Science (2018). *https://doi.org/10.1007/s10699-018-9557-z*.

brain-consciousness system, and how it is able to collapse the former structure in what we can call "color states".

How fit is the 'structure of human color states' to capture the 'structure of e.h.f.r.', this is something we can only know when walking the research path, when dealing for instance with situations where some anomalies and ambiguities will start to be observed, so we will be compelled to introduce new, more advanced notions and concepts to disambiguate them, design more fine-grained experiments, using new measuring instruments, able to access aspects that our eye-brain-consciousness cannot, etc.

So, I think we can agree that our experience of the world will introduce limitations, it is kind of inevitable. If I open a hole in a wall, to see what is on the other side, the hole will allow me to "see something," but at the same time it will condition my perception. I can open different holes, some larger and some smaller, and I can even send flying drones on the other side, but they will only inform me about the reality on the other side through their photographic lenses, which are again holes of some kind…

The picture I will be able to construct, will therefore be conditioned by all these "subjective" viewpoints, strongly dependent on the instruments we are using to interact with reality, and the fact that, indeed, our vision will be always a mediated (by interactions, by instruments, by bodies, even by minds, etc.) vision. But nevertheless, it will still tell us something objective, something that is about the structure emerging from the 'encounters of two structures', if you will.

Now, I fully agree, we can and should have always in mind that we are constructing something. In the first place, there is a oneness, and then we might be interested in discovering 'how' this oneness is one (as Poincaré liked to say). And in this process of discovery, we will also become aware that our discovery is in part also a creation, because we cannot discover a structure without altering and creating part of it at the same time.

But you see, this does not mean that we cannot obtain a gradually deeper understanding about the nature of that oneness, of its

original structure, by studying attentively what structures will emerge when we ask them questions about its structure.

Our questions contain already some structure, I agree, so we are inevitably coloring (with some nice purple?) the answers we will receive, and we have to always remember that the purple color is not in the oneness as such, but there is "something" out there that undoubtedly resonates with 'purple', so, through the 'purple lenses', I can still contemplate part of that aspect.

Then, it is all about trying a "reverse engineering" of reality. How much are we able to reconstruct what produced all these emerging structures we observed with our instruments meeting reality? You can think for instance of the quantum mechanical Hilbert spaces[19] as a timid tentative to try to capture the structure of the "undisturbed oneness."

But for sure, in a standard scientific approach to reality, there can be intrinsic limits in such reverse engineering process: the biggest part of the oneness structure and of its nature might forever remain hidden to us, where 'us' can be 'us manifesting with this three-dimensional body', but also 'us possibly manifesting with more subtle vehicles, like those described in many traditions of our planet', which our individual consciousness might use to manifest when the physical body is deactivated.

We can imagine paraphysicists doing physics with these parabodies, with parainstruments, in a paraphysical reality, etc., and we can imagine again that also in such extraphysical, "spiritual" realm, the same issues we are discussing will arise: a part of reality, which we might call the 'unmanifest', will remain behind the scenes, and we will only be able to see it by making it 'manifest' in some way.

[19] From Wikipedia: the mathematical concept of a Hilbert space, named after David Hilbert, generalizes the notion of Euclidean space. Hilbert spaces arise naturally and frequently in mathematics and physics. In quantum mechanics, the possible states (more precisely, the pure states) of a system are represented by unit vectors (called state vectors) residing in a complex separable Hilbert space, known as the state space.

But the process, as the word 'revealing' indicates (to put a veil twice), if on one side it will allow us to see the unmanifest (the realm of potentiality), it will also in a sense break it, and thus veil it again, because 'potentiality is broken by actuality', and there are so many ways potentiality can be broken into actualities, so we should never pretend to be able to fully know what 'potentiality is' by just knowing how it can be broken into actualities.

But also, I believe we should never pretend that these fragments of actualized potentiality would have nothing to do with what they originated from, and would not also constitute, in a sense, objective elements of reality.

WILLIAM: I am not suggesting that the observer does not need to be an active part of the detection process; of course, there must be an interaction of some kind. I am only suggesting that the interaction produced by a detector placed by a slit has some unique qualities compared to rocks or other things incapable of "detection/observation."

Essentially, I am suggesting that observation is a unique form of interaction. So, a question that comes to mind for me would be: when a simple light source (or one similar to that produced by a detector) that is not connected to any detector mechanism is aimed at one of the slits, does it bring about the same either/or collapse as an actual functioning detector? If it does, well that seems to go a long way to taking the mystery out of the problem. If it does not, then this seems to suggest some unique qualities for interactions involving true observation.

I think you've put it well when you write that we can (only?) gain knowledge by observing the: "structure emerging from the 'encounter of two structures'." My point is exactly this: that we can only actually observe "emergent structures," and that these emergent structures are always reducible (i.e., conditional) relative to some encounter between two sub-structures. Therefore, I would argue that it is only via the hole in the wall (i.e., our eyes and brains) that structure of purple emerges from an interaction between some two structures wherein the emergent structure of purple is utterly without definition or meaning.

In the case of studying and observing e.h.f.r., what we've done is to simply broaden the number of entities that can "detect" (i.e., synthesize) the interaction. That is, seeing purple is only a specific kind of structure that emerges from an encounter with an e.h.f.r., and only a very few entities can actually see the color purple. However, when we broaden the character of the emergent structure to include more effects of light on entities, then we are not just putting more holes in the wall for we humans to look through, we are actually increasing the number of entities that can processes the interaction for themselves; i.e., we are "lowering the bar" for what we typically consider as "observation."

However, imagine that everything could "see" purple; would that make purple any less of a conditionally emergent structure simply because nearly everything could see it? I would say, no, that there must still always be two, non-purple structures encountering each other for purple to be produced and that ultimately these two make up a single system. But since you wrote that we: "should have always in mind that we are constructing something," perhaps you agree?

I completely agree that we can obtain a gradually deeper understanding about the nature of oneness by studying how and which structures emerge, and I have great respect for the "reverse engineering" approach. What I think is under examination/discussion/debate are the different assertions put forth by the various models being proposed.

I agree with some of what you say concerning the nature of potentiality and actualization. However, as they say, "the devil is in the details." When we get into this territory, we (finally) get to the argument that the ancient Indians started about 1800 years ago: what is the nature of the one great Reality?

There are two essential arguments, the first suggests that potentiality has its own nature as background (Yogachara[20] approach),

[20] From Wikipedia: *Yogachara*, literally "yoga practice," "one whose practice is yoga," is an influential school of Buddhist philosophy and psychology emphasizing phenomenology and ontology through the interior lens of meditative and yogic practices.

and the second (via the Indian philosopher Nagarjuna) holds that potentiality and actuality are inseparably identical (Madhyamaka[21] approach). But this is quite a subtle (though interesting!) topic that you might not be interested in. By the way, thanks for taking the time for this thread!

MASSIMILIANO: Thanks William, for taking the time as well for this interesting exchange. First of all, regarding observation, let me say that even though observations will in general also have creation aspects – the so-called observer effect – one can certainly also consider ideal observations that are pure discovery processes, with no creation involved at all, i.e., such that no new properties are created (actualized) by the observational process.

This is how the very notion of observation is usually understood, hence the term is sometimes used as a synonym of a 'pure discovery process'. Because asking a question is certainly a way to obtain information, but sometimes you don't even have to. We all know people that always speak, even when no questions are addressed to them. These entities provide data to the universe spontaneously, and if we collect such data, we can observe those entities (at least, some aspect of them) without actually disturbing them in whatsoever way. As I wrote once in a 2013 precisely about the observer effectarticle, I quote from it:[22]

"Imagine yourself in a forest. Your eyes are wide open and you simply look at the trees surrounding you. In other terms, using your eyes and brain as an observational instrument, you detect the sunlight reflected by the trees, and by doing so you gather information about some of their properties, like for instance their spatial locations, dimensions, variety, colors, and so on. A crucial point in this observational activity is that it is completely non-

[21] From Wikipedia: *Madhyamaka* ("Middle way" or "Centrism") refers to a tradition of Buddhist philosophy and practice the foundational text of which is Nagarjuna's Mūlamadhyamakakārikā (Root Verses on the Middle Way). More broadly, it also refers to the ultimate nature of phenomena and the realization of this in meditative equipoise.

[22] Massimiliano Sassoli de Bianchi, "The Observer effect," Found. of Sci. 18, pp. 213-243 (2013); doi: 10.1007/s10699-012-9298-3; arXiv:1109.3536 [quant-ph].

invasive with respect to the observed entities. You observe the trees but your observation has no effect on them.

It is probably from observational examples of this sort, which are typical of the interaction of human beings with their natural environment, that a sort of prejudice emerged, that we have the tendency to believe in an almost unconscious way: that it is always possible to observe the countless entities populating our reality without disturbing them, i.e., without influencing their state and evolution.

The reason for the development of such a prejudice is quite obvious. We live in a terrestrial environment that is almost constantly illuminated by the light of our sun or the indirect light of our moon (and in more recent times by the artificial light of our appliances). Therefore, the entities populating our macroscopic reality are constantly emitting light, be it the light they directly produce or the light they reflect. This is how we came to know these entities (of course, we are simplifying here, as not only the visual sense is involved in the discovery of our environment), so that we usually consider them as being in their undisturbed condition when they do actually emit direct or indirect light. Thus, we believe that observing them is about collecting something they spontaneously offer to us, as if they were constantly sending messages out to the world, informing it about their actual condition.

To put it figuratively, it is as if the world was constantly talking to us, without us asking anything specific, like a person performing a monologue, speaking her/his thoughts aloud to whoever is willing to listen. And by doing so, by listening to the messages that are spontaneously emitted by the different entities populating our reality, we are able to discover many of their attributes and properties. So, we could say that our most basic and common understanding of the concept of observation is that to observe an entity is to discover what an entity is, without affecting its "isness" in whatsoever way.

This way of understanding the concept of observation, as a pure act of discovery, is also deeply rooted in physics, in the formalism of classical mechanics, although in an invisible way. Indeed, since

observation is believed to have no effects on what is being observed, as it is just an act of discovery of what is already present in a system, there is obviously no need to explicitly represent the observer in a physical theory. Therefore, classical theories describe the states, properties and the evolution of physical entities by assuming a priori that such states, properties and evolution would be the same, should they be observed or not observed (i.e., discovered or not discovered) by an observer (typically a human scientist with her/his experimental apparatus)."

Ok, this was just to point out that before the advent of quantum physics, the default understanding of observation was that it was only, ideally speaking, a discovery process. But, if a system is "silent," and you want to acquire knowledge about it, then for sure you have to disturb it, and by doing so you will be able observe aspects of that system that otherwise you might never be able to "see."

This by the way reminds me of Heinz von Foerster's aesthetic imperative:[23] "If you want to see learn how to act."

Anyhow, I think that indeed we can agree on the view that, in a sense (and the "in a sense" is important) properties emerge from our observation/measurements, and that one can therefore defend the view that, in a sense, they do not exist in the absence of the observers. But then we have to take care not to mix two aspects. The first one is about saying the following.

We humans, as cognitive entities, have considered, even invented if you will, certain experimental tests, which include protocols to be followed to perform them and the interpretations for the associated outcomes. To these experimental tests, or 'experimental questions', we have associated properties. In the sense that we say that a given entity possesses (in actual terms) a given property if, should we subject the entity to the experimental test

[23] From Wikipedia: *Heinz von Foerster* was an Austrian American scientist combining physics and philosophy, and widely attributed as the originator of Second-order cybernetics. He is well known for his 1960 Doomsday equation formula published in Science predicting future population growth.

defining the property, the successful outcome would be certain in advance.

Well, to be more precise, since some tests are equivalent, one associates properties with 'classes of equivalent tests', not with single tests, but this is a technical point. What I want to say is that I have no problem in considering that, since the physical properties have been defined, conceived, imagined, thought about, even invented by us humans, there is a great deal of subjectivity in them. From that standpoint, one can rightly affirm that these properties are not really "out there," but mostly in the minds that are trying to conceptually map the word by using certain notions instead of others.

In other words, they would just be part of our human culture. In particular, they would not be out there because one always needs to interpret the effects of certain interactions in order to be able to say that these effects correspond to the 'confirmation of the actuality of a certain property'. Where are the spatial positions, in a reality where the very notion of position has never been conceived in the first place? Our facts, no doubts, are imbued with theories and abstract notions, and one can certainly argue that these are not integral part of the reality we observe.

The above is also a way to expresses the fact that we certainly have a very parochial perspective on our world (and I believe also on ourselves). We could say that the answers we get, when we ask questions, are more revealing of the questions we are asking than of the reality of the entity replying to those questions.

Fair enough, we can certainly defend such point of view, but I think only to some extent, otherwise we fall into solipsism (which is a bad philosophy in my view). Because the responses we receive also contain objective aspects, revealing in part also the nature of the entity responding. As the answers, first of all, are not personal: if a given observer can predict an answer, another observer can in principle also do the same.

So, there is an element of objectivity, expressed as intersubjectivity. Also, even though some answers (those that cannot be predicted in advance) are created on the spot, during the

interrogative process, the 'way they are created' is predetermined, and therefore again intersubjective.

In quantum physics the probabilities are well-defined, they are in a sense the new elements of reality, because even though I cannot always predict an outcome, I can always predict the probability of the outcome (using the Born rule). Hence, there is no indeterminism in the 'way' the system answers my questions' (it always answers according to the 'Born way'), hence there is an aspect of my questions that always capture something that exists independently of them, both in the situations where I can predict the answers, and in those where I cannot.

Now, will my present and future questions allow me to capture in a complete way the reality of an entity "out there," or the whole of reality? Well, that's a different kettle of fish.

But coming to the first part of what you write, for sure you need the screen detector to evidence that the presence of a light source will destroy the fringe (interference) pattern. So, yes, indeed, you need that unique form of interaction that we call an observation.

In the double-slit experiment we can say that the observer is the final detection screen. In the 'conceptuality interpretation of quantum mechanics' that was proposed by Diederik, we speak more in terms of 'cognitive entities' interacting with 'conceptual entities', where a cognitive entity is a mind-like entity, sensitive to the meaning that is carried by the conceptual entities.

So, in this view, interactions of the cognitive kind would not be special, but the default ones. And the emergent structures we observe is what we call 'meaning', which indeed is constantly discovered & created during our cognitive interactions.

This 'conceptualistic view' implies that there are essentially two kinds of entities "out there," so there is a sort of fundamental duality in our reality: those that carry meaning and those that are sensitive to such carried meaning. We humans are an example of cognitive entities sensitive to meaning, but physical entities would also typically exchange meaning in processes that are genuinely cognitive-like.

That's why we recently explicitly proposed a 'pancognitivist worldview', where everything within reality would be assumed to participate in cognition, with human cognition being just an example of it, expressed at a very specific organizational level (see the article: "Quantum perspectives on evolution," which I had the pleasure writing with Diederik[24]).

Of course, this demarcation between cognitive entities and conceptual entities can be fuzzy at times, but in our physical world it would originally manifest at the level of the distinction between bosons and fermions, the former being the archetype of conceptual entities, and the latter of cognitive entities. Or, to say it better, fermions can produce (mind-like) structures that will become sensitive to meaning (the stability of matter), whereas bosons cannot do (they cannot be used to create stable structures, because there isn't the constraint of Pauli's exclusion principle).

So, yes, emergence, in a sense, is everywhere, as all interactions would be meaning driven (with human meaning and human culture being just a small part of the cosmic meaning and culture), and meaning is immersing and emerging in all cognitive-like interactions. All this still allows in my view a realistic perspective on the world. It is the substance of the entity populating reality, the physical world and the physical interactions, that would be different than initially expected: much more similar to the substance of our human cognitive processes.

WILLIAM: Massimiliano, you write concerning the classical understanding of observation: "if we collect such data, we can observe those entities (at least, some aspect of them) without actually disturbing them in whatsoever way." Such an approach (as you seem to agree) is based on a more "traditional" materialist point of view that implies the affirmation of pseudo-intrinsic limits (extrinsically determined) for the entity being observed.

[24] Published in: The Map and the Territory: Exploring the Foundations of Science, Thought and Reality. Shyam Wuppuluri, Francisco Antonio Doria (eds.) Springer: The Frontiers collection, 2018 (pp. 571-595); doi: 10.1007/978-3-319-72478-2.

Without doubt this approach has had practical value for thousands of years… and probably will for a thousand more.

However, in my opinion, in light of the discovery of quantum physics, the inaccuracies of such a view becomes more and more apparent, it becomes vitally important to identify and adopt a more factual description of the nature of reality that must by necessity be compatible with both quantum and classical level observations. With this view (as you write later in your post) you apparently agree.

I agree that overly solipsistic arguments are to be avoided. However, I also believe solipsism, as long as we allow for the fact of variation between entity-contexts, should not be completely disparaged. That is simply to say that entity-contexts don't need human awareness (disturbance via observation) or interaction with stable molecules to collapse themselves into their own "version" decoherence.

You wrote: "We humans are an example of cognitive entities sensitive to meaning, but physical entities would also typically exchange meaning in processes that are genuinely cognitive-like." Fair enough, but strange as it might sound, I feel I must speak up for the poor bosons and freely moving fermions whose intrinsic states should only be understood (according to the view you put forth) as "conceptual" or "carrier-entities" simply because they haven't had the good fortune (or bad luck?) to be sucked into some darn "cognitive-entity's" business! ;-)

When we define relatively coherent states only in terms of our own intrinsic state of decohered reality, it is like saying (to use the color metaphor again) that high electro-magnetic energy is some kind of second-class carrier-entity until it has the "luck" of heating up some rock or "conveying meaning" by being seen as "purple" by some human or bumble bee. How is this not just "decoherent racism" ;-)

Why should "meaning" be given such importance? The freely moving boson or fermion doesn't give a fig about any potential meaning it might or might not convey. Kidding aside, isn't trying to define all the different levels of entity-contexts realities in

terms of "conceptualistic" behavior doing exactly what was tried when the general scientific trends tried (and failed) to describe reality solely in terms of either the classical (deterministic) or quantum (probabilistic) behaviors? Why should one now over-emphasize the importance of the conceptualistic behavior over the other two?

Diederik, I think that there is still more work needed in finding an agreed upon interpretation of what we mean when we use the words: subjective experience. What I mean by subjective experience are autopoietic systems that (most probably) emerge from "under-laying" non-autopoietic systems.

I like to use the term "agency" to represent such subjectivity, as it seems to me that every entity-context has its own version of subjectivity. Likewise, I don't really know what you mean when you say that (some) Eastern philosophical views blur the line between reality and dreams.

In my experience, such descriptions are typically polemic tools only employed to shake the beginner from their usual apprehension of material reality as being in any way unconditional. One can really dig deeply into the subject, but I believe that when one studies the general Eastern approach in depth, it is in no way in conflict with Pasteur's discoveries.

MASSIMILIANO: William, you ask: "Why should 'meaning' be given such importance?" Well, it certainly must not be given a priori, but it seems that by viewing 'meaning' as the "currency" of universal exchange between the countless entities forming our physical reality (and not only), at their different levels of organization, this offers quite some powerful explanations about the behaviors and interactions we can witness "out there." Hence, it is a hypothesis which, despite its speculative nature, is worth investigating, at least in my view :-)

WILLIAM: I also agree the hypothesis is worthy of investigation. I'm also investigating it for myself by way, from what I have read of yours and Diederik's writings and via this dialogue :-)

DIEDERIK: There is a thing I can add to Massimiliano's argumentation, William. This hypothesis underlying our conceptuality interpretation of quantum theory did not come about for philosophical reasons, e.g., because we would enjoy the idea that the foundation of reality is conceptual, or we would prefer a panpsychist worldview to a materialistic worldview. It came about, rather, purely from technical considerations.

Concepts inherently contain an ontological Heisenberg's uncertainty principle (a concept cannot be concrete and abstract at once, and the more it is abstract the less it is concrete, and vice versa), and quite some other purely technical aspects of quantum theory in an unexpected way become understandable – another one is the identity of quantum entities: concepts are indeed really identical, which is never the case with objects.

If a specific hypothesis comes about because being data driven rather than philosophically desired, it carries more credibility with it. Indeed, reality is what it is, this is one of the most profound of its properties, and not what we would like it to be.

WILLIAM: Diederik, I can appreciate that your hypothesis is founded upon more than simply philosophical ideas. I like to think that my comments are also not based only on philosophical ideas, and I am certainly not a panpsychist. Essentially, I think that you and your team are making an interesting attempt at a new way of looking at the world.

However, I also suspect that there are some potentially problematic issues. The first is centered around the ambiguity of what "a concept" fundamentally is. That is, it seems to me that the underpinning for your approach rests on some philosophical speculation about the nature of information (vis-à-vis; conceptuality) which doesn't really have a solid foundation in empirical understanding. That is, we don't even have a working scientific model for the general phenomenon of information, how can one posit an empirical basis for any subtler expressions of it (e.g., conceptualization)?

I wonder what your thoughts on the topic of 'information' are, because it seems to me that any employment of the term "conceptuality" must also be an expression of information.

Does your model propose a new way to understand information itself? Second: I guess I don't really see how the fact that "concepts cannot be concrete and abstract at once" can be correlated to the speed and location (or other complementary variables) of a particle in Heisenberg's uncertainty principle. That is, a concrete concept and an abstract concept refer to two different "objects" (e.g. apples and apples grown in Washington state), whereas Heisenberg's Uncertainty principle deals with knowing either the speed or location of a single particle (or object of focus). That is, states of either dynamism or staticity.

MASSIMILIANO: I do not want to answer for Diederik, also because we have not so much discussed together specifically about the notion of 'information' in our collaboration (which in itself already suggests that we do not consider this notion as fundamental), but let me just say the following, William.

Consider the famous "it from bit." In the words of Wheeler,[25] it: "symbolizes the idea that every item of the physical world has at bottom — at a very deep bottom, in most instances — an immaterial source and explanation; that what we call reality arises in the last analysis from the posing of yes-no questions and the registering of equipment-evoked responses; in short, that all things physical are information-theoretic in origin and this is a participatory universe."

There are certain things in this quote on which I agree, others on which I have to agree to disagree. I do agree of course on the importance of yes-no questions, as these are precisely the

[25] From Wikipedia: *John Archibald Wheeler* was an American theoretical physicist. He worked with Niels Bohr in explaining the basic principles behind nuclear fission. Together with Gregory Breit, he developed the concept of the Breit–Wheeler process. He is best known for linking the term "black hole" to objects with gravitational collapse already predicted early in the 20th century, for coining the terms "quantum foam," "neutron moderator," "wormhole" and "it from bit," and for hypothesizing the "one-electron universe."

'experimental tests' defining properties, and if we take seriously the idea that measurements are interrogative contexts, and equipment are like cognitive entities providing answers, then of course such view is very close to the idea of the 'conceptuality interpretation', indicating a fundamental interplay between conceptual and cognitive entities.

But to say that reality 'arises' from the posing of these questions, this is a too radical statement in my view. It is too radical because both aspects of 'creation' and 'discovery' are to be taken into due account.

Quantum states, for instance, do not describe a mere 'state of belief', or 'degree of belief' of the cognitive entities involved in a measurement, but truly, in my view, the 'state of affair' of the conceptual entities subjected to the measurements operated by the cognitive entities. Of course, the 'mental state of the cognitive entities' will also play a role, but at a different level in the theory, actually, at a level that is not described in standard quantum mechanics.

What is it? It is the level of description of what goes on "behind the scenes" of a quantum measurement. It is also the level of description of 'the way in which a cognitive entity chooses an answer to a given question'. Each cognitive entity will in principle answer in a different 'way', associated with a different set of outcome-probabilities, but when you consider 'all possible ways of answering a question', in what we have called a 'universal average', or 'universal measurement', you fall exactly on the quantum (Born) rule of probabilistic assignment; see for instance the booklet I wrote with Diederik entitled "Universal Measurements" (World Scientific, 2017).

Having said that, let me just stress the fact that the notions of 'information' and 'conceptual entity', although of course they do intersect at some level, they are certainly not equivalent (not in my view at least). The way we use the notion of 'conceptual entity', in the 'conceptuality interpretation', is more as a synonym of 'meaning entity'. A conceptual entity is really 'an entity carrying meaning'.

So, are the notions of 'meaning' and 'information' similar? Well, I guess it depends on how you define them. What they certainly have in common, is that you can speak of the information carried by a message, independently of the nature of the carrier (engraved in stone, written with ink, expressed aloud, etc.). The same is true for the meaning carried by a message. And yes, sometimes we use 'information' and 'meaning' as almost synonyms, when for instance we say that a given message is very informative.

But 'meaning', in my view, is much more fundamental. If you consider its etymology, information it is about "giving form to something," so, in a sense information refers to a collapsed state already, like that associated with a written text. On the other hand, 'meaning' is more at the level of what was able to produce the information contained in the text.

So, I see 'information' more as a 'collapsed form of meaning' (and of course, I'm here referring mostly to the notion of information in its classical sense; then you also have so-called 'quantum-information', which however I see as a neologism precisely indicating the 'more fundamental level of meaning').

Regarding your last comment, all the interest of the (operational-realistic) conceptuality approach/view is precisely in the possibility for a 'conceptual (meaning) entity' to be in different states. But there is certainly quite some flexibility in doing so. So, 'apple' and 'apple grown in Washington state' can be considered as two different possible states of an 'apple' conceptual entity (or of a 'fruit' conceptual entity).

Of course, you can also say that these are just two different conceptual entities. But the same happens in physics, when you also start considering 'quantum-field entities', where you can have states characterized by different numbers of 'field's quanta', each quantum being in different possible states.

By the way, Diederik, William and Valéry, this has been a really interesting conversation. I do not know if it will continue for a long time still, as I kind of feel that it is now reaching its natural end. Being of quite high quality, I would like to preserve it and

publish it in my journal AutoRicerca. Would you be on board about this possibility?

DIEDERIK: Hi William, sorry that I did not find the occasion to react earlier to your the questions and comments you put forward in your last post above, I was taken by the urgencies with our two students Suzette and Lester participating in the mid-term meeting of the project QUARTZ[26] they work on, actually both working on a subject intimately linked to the subject of our conversations here.

I see that Massimiliano reacted already to your interesting challenge of entering 'information' in the discussion, and how it would be related to conceptuality. I can add some thoughts to the ones already formulated by Massimiliano. Information, at least as defined by Shannon, and this is also the way it is employed in the practice of the memory storages of the computers that we all use, is quite a different notion from conceptuality, and it is easy to see this by looking at some examples.

If you tape with your computer an episode of mostly noise, and it takes 10 megabytes on your hard disk, you have 10 megabytes of information on your hard disk, indeed all bits have been positioned in a 0 or 1 state, for a total amount of 10 megabytes. Instead of taping mainly noise, you can also tape a very important conversation you have with one of your friends, where you talk about the interchange of ideas we had in this thread, for example. The first 10 megabytes is mainly meaningless, while the second 10 megabyte is a taping of a big amount of meaning. So, more than emphasized already by Massimiliano above, it is my view that information and meaning (and hence conceptuality) are crucially different substances.

[26] QUARTZ (Quantum Information Access and Retrieval Theory) is an Innovative Training Network (ITN) that aims to educate its Early Stage Researchers (ESR) to adopt a novel theoretically and empirically motivated approach to Information Access and Retrieval (IAR) based on the quantum mechanical framework that gives up the notions of unimodal features and classical ranking models disconnected from context.

If I make a link with the beginning episode of this exchange of ideas, I can express their difference in a much deeper way. Conceptuality and meaning are really the substance of 'matter, life, culture', and also already the substance of 'being'. Information, however, in the Shannon way, does not make any distinction about all this, and hence situates itself almost independent of the evolution we considered in the beginning episode of this thread of exchange of ideas.

I would, for example, situate 'conceptuality and meaning' much closer to 'knowledge' than to 'information'. So, I have never been a fan of Wheeler's expression 'it from bit', because I see this idea rather in the prolongation of an attempt of explaining quantum theory without adding any new explanation at all. Now, often people in the common words of everyday life use the notion of information not like Shannon defined it, and they mean rather something similar to knowledge ('meaningful information') and hence would not consider the 10 megabyte of noise as containing the same amount of information as the 10 megabyte of meaningful conversation.

But that type of 'meaningful information' is not well defined, and it is definitely not that type of 'meaningful information' that Wheeler talked about when he put forward the sentence 'it from bit'. The word 'meaning' is the essential word in the expression 'meaningful information' and not the word 'information'.

Going again back at the initial subject of this thread of exchange of ideas, within the 'conceptuality interpretation' it is crucial to look at the 'evolution of the world' as a process of 'concentration and focus on meaning', and not as an 'information processing mechanics'.

Now, it is interesting to bring up the research domain of 'quantum information', like Massimiliano also already did. Quantum information has many peculiar properties not at all even intuitively shared by classical information. All the properties that hang around the 'no-cloning theorem' for example, and there is something called 'quantum monogamy' (if a quantum entity is mostly entangled with 'one' other quantum entity, and a third entity is subsequently involved, the entanglement that will govern

the three will be always less), which all indicate that 'information' is most probably a misnomer.

If the conceptuality interpretation is correct – and I still like to write about it as a hypothesis, because the consequences of it being correct are enormous – quantum information is "not" about information, but about 'meaning'.

Let me give some other examples to show the fundamental difference between information and meaning. A garbage belt on the outskirt of a city contains the same amount of information as the library (in analogy with the 10 megabyte of noise one can tape and the 10 megabyte of you talking with a friend on the subject of our exchange of ideas), but when it comes to 'meaning', the garbage belt is almost empty, while the library is very full.

We have called our interpretation the 'conceptuality interpretation', but we could have called it also the 'meaning interpretation'. The reason we called it 'the conceptuality interpretation' is because its principal starting point was the 'de Broglie' move with respect to 'quantum cognition'. But you see, when quantum structures are used to model human cognition and decision, it is not at all a modeling of information. It could be seen as a modeling of the information processes specifically taking place when human minds talk to each other. That is however a place within human culture similar to the library and not similar to the garbage belt.

The fact that meaning is exchanged in human cognition and decision is crucial for quantum structures to be of value to model what happens there. What happens when you tape 10 megabytes of noise, and a focus on that, is what information is about, and it is in principle unrelated to meaning and the conceptuality that is ongoing in human cognition and decision. This is also the reason why we have made the comparison between 'meaning' and 'quantum coherence', both are substances that appear after a process of 'matter, life, culture', starting from 'being'.

Let me mention one more thing where the difference between 'it from bit' and the 'conceptuality interpretation' is put into perspective. The conceptuality interpretation relies in some way on

a duality, mind and language, and concepts play as structures an essential role in this duality, which is why we use them all the time in our lives. On the fundamental level matter is on the side of mind and force fields are on the side of language. Hence, fermionic nature is on the side of mind, while bosonic nature is on the side of language.

Supersymmetry,[27] which was aimed to find traces of at the CERN after the identification of the Higgs boson,[28] actually would destroy this duality – or, better, rests on a hypothesis that in the beginning of the universe this duality is not present. Within the conceptuality interpretation it is plausible (although not necessary) that the duality is older than the universe, and supersymmetry not being encountered where it was expected actually points in that direction.

Now, to react to you question about 'how Heisenberg's uncertainty in its space-momentum form' can be understood from its 'abstract-concrete' form like we see it in concepts. The idea is the following. Time-space would be much more parochial than usually imagined. And when venturing in the depth of physics, even already in classical physics, there are strong indications for this. Even in the old classical physics of Hamilton (the Hamiltonian version of Newtonian physics[29]), there is an amazing duality

[27] From Wikipedia: in particle physics, *supersymmetry* (SUSY) is a principle that proposes a relationship between two basic classes of elementary particles: bosons, which have an integer-valued spin, and fermions, which have a half-integer spin. A type of spacetime symmetry, supersymmetry is a possible candidate for undiscovered particle physics, and seen as an elegant solution to many current problems in particle physics if confirmed correct, which could resolve various areas where current theories are believed to be incomplete.

[28] From Wikipedia: the *Higgs boson* is an elementary particle in the Standard Model of particle physics, produced by excitation of the Higgs field. Its existence was experimentally confirmed in 2013. In mainstream media the Higgs boson has often been called the "God particle," for its role in explaining the generation mechanism of the property "mass" for bosons.

[29] From Wikipedia: *Hamiltonian mechanics* is a theory developed as a reformulation of classical mechanics and predicts the same outcomes of the latter. It uses a different mathematical formalism, providing a more abstract understanding of the theory, which contributed to the formulation of statistical mechanics and quantum mechanics.

between on the one hand ‘time and space’ and on the other hand ‘energy and momentum’.

Since we now live in a time-space universe, while energy and momentum play a totally different role in how we perceive things from our vantage point of a mind connected to a macroscopic material body on the surface of a macroscopic entity such as a planet, a deep symmetry breaking must have taken place somewhere, and even before what we call now the beginning of our universe (the big bang).

This is, by the way, also the reason to believe that if the conceptuality interpretation is correct, the duality mind-language, boson-fermion, was present “before” the big bang, and supersymmetry actually hypothesizes that this is not the case.

Anyhow, whether this huge symmetry breaking took place before the big bang or after is not even the essential question. What we have not at all understood is ‘what is the nature of this enormous symmetry breaking?’, where we end up now in our niche where time-space are ‘extensions’, while ‘energy-momentum’ are properties of entities being inside this extension.

I have written some articles about this issue, albeit in a somewhat different setting, and also worked on it with Massimiliano later, I will give some references in the comment spaces below. The main idea is that there is a symmetry breaking centered around the ‘coming into existence of macroscopic matter’ and the ‘coming into existence parallel with the space-times’ and then the erroneous approximative view that this macroscopic matter would be ‘objects present in this space-times’.

Hence, at the same time, since we as persons are minds linked to bodies, and our bodies are such macroscopic matter, from our parochial vantage point we have built our first worldviews not being aware of this symmetry breaking. The deep analysis of the laws of physics, and hence the revelation of this symmetry, already in classical mechanics, its Hamiltonian version, made us become aware of this symmetry.

Now, looking at human language, we can identify even there the symmetry breaking I put forward here, exactly on the level of

concepts. It is the symmetry breaking between ‘and’ and ‘or’. The connective ‘and’ tends towards extension, while the connective ‘or’ penetrates inwards. There is the following even rather funny state of affairs. If we say ‘chair and another chair’, and we consider them as two objects, then ‘chair and the other chair’ remain two objects, and they need extended space to even make sense to the connective ‘and’.

If we however say ‘a chair or another chair’ (for example, ‘a chair in one room, or a chair in other room’), we are ‘outside of space-time’ already, right away. An object A ‘or’ an object B is no longer an object. The notion of ‘object’ breaks the symmetry between ‘and’ and ‘or’.

The notion of concept does not break this symmetry at all. Connecting two concepts by ‘or’ leads to a more abstract concept, while connecting two concepts with ‘and’ leads to a more concrete concept. In human language the symmetry is broken in a very similar way than in our material universe.

I have analyzed this situation quite deeply in another article, which I also will give the reference down here in a new comment. Again, to picture shortly what this symmetry breaking is about, the connective ‘and’ puts concepts together in a space-like way, leading to extension. However, the connective ‘or’ allows the creation of small entities where inside the entity the ‘or’ dynamics (which is pure quantum, by the way) governs.

The examples I identified in human language are ‘tea or coffee’: there are a lot of webpages in the World Wide Web where this combination appears, and we know why, because it is such a little atom appearing as an entity in the extension of human language. ‘Dead or alive’ is another one, ‘door or window’ is another one, etc. Now we “know” that in our language the connective ‘or’ is equally valid as compared to the connective ‘and’, and in the deep structure of language, logic, there is even a complete symmetry between both.

That human language already breaks this symmetry in a similar way, like using a mirror, to the way it was broken in our material universe, is, in my opinion, due to it being rooted and having been

conceived with a subject of conversation being in great part this material universe around us. The proto-language of bosons, hence photons in our electromagnetic universe, in depth has not broken this symmetry.

By the way, there is a funny, but very enlightening way, to see directly the error that is made by the Many-Worlds interpretation of quantum theory. The Many-Worlds they put forward are connected by the 'or' connective, and not by the 'and' connective. They are of the form of the little language atom 'tea or coffee', and not 'tea and coffee' (what a mess would that give in a reception, to be put tea and coffee in your cup, and indeed, the Many-Worlds interpretation is a mess).

There is a second error, equally messy, that is made by the Many-Worlds interpretation, and that can be understood when looked at things from the perspective of the conceptuality interpretation. It is the following. If we think that 'stories' are the main big size entities that we as humans fabricate with our language, then we can identify the symmetry breaking also there. 'Story A and Story B', can often still be considered as a story again. This is why we can conceive of a book containing different stories. 'Story A or story B', we do not have strong desire to consider this as a story again. Although there are definitely stories, and detective stories are good examples of it, that keep the 'or' going the whole way down the story, and only at the all end give us the relieve of our customary symmetry breaking in reveling which one of the 'or' story lines was the true one all along. Agatha Christy's novels are a good example.

In the Many-Worlds interpretation one does not only mess up the 'tea or coffee' to put 'tea and coffee' in your cup, but one also imagines that if a person with a body being a macroscopic material entity makes a choice, also the other choice realizes in a parallel universe. It comes to believing that if a story is being told, each time the connective 'and' is being used, actually all other possibilities that are compatible with the connective 'and' at that place are also stories that are being told in parallel. Again, a deep confusion between 'and' and 'or'.

I give here some references to the two comments I wrote above. In "The unification of personal presents: A dialogue of different world views," I explore this symmetry breaking between the 'outside' and the 'inside' (in a slightly different setting, mainly due to the type of invitation I received for this article).[30]

In "Quantum Theory and Conceptuality: Matter, Stories, Semantics and Space-Time," I explore in a more direct wat the symmetry breaking between outside and inside on the level of human language, and how it is related to a similar symmetry breaking for our entire universe, inspired by the conceptuality interpretation.[31]

By the way, I read above about the possibility of using this exchange of ideas for your publication Massimiliano, and I agree, this is really an interesting exchange in a dialogue form, so I find it an excellent idea, I hope that William and Valéry also like it.

WILLIAM: Massimiliano, sure, sounds great. I also thought things were winding down, but I think that this new topic of meaning and information is a fascinating new direction.

MASSIMILIANO: Thanks, Diederik, for this last important "piece of information," and thanks William, for also supporting the idea of using this material in a future publication of AutoRicerca. Of course, the idea is to keep the above thread exactly in its actual form, modulo corrections of small typos and oversights here and there, then specifying in the editorial of the volume in which it will be published that it is a spontaneous exchange of viewpoints, written in a very informal way, that is, not as an essay, hence the

[30] Diederik Aerts (2011), "The Unification of Personal Presents: A Dialogue of Different World Views," in: Ontology of Dialogue: The International Readings on Theory, History and Philosophy of Culture, ed. by Moreva, L.M. (The paper can be downloaded from: the author's website at: http://www.vub.ac.be/CLEA/aerts).

[31] Diederik Aerts, "La mecànica cuántica y la conceptualidad: Sobre materia, historias, semántica y espacio-tiempo," Scientiae Studia 11 (2013), pp. 75-100, doi: 10.1590/S1678-31662013000100004. Translated from: "Quantum Theory and Conceptuality: Matter, Stories, Semantics and Space-Time," arXiv:1110.4766 [quant-ph]. See also this volume, page 109.

overall structure of the text is exactly as life is: with many islands of stability and instability :-)

And I agree William, this new topic of the interplay between meaning and information is a fascinating new direction, so let us keep it for potential future conversations.

Valéry, do I also have your approval to proceed?

VALÉRY: yes, it's ok for me.

QUANTUM THEORY AND CONCEPTUALITY: MATTER, STORIES, SEMANTICS AND SPACE-TIME[1]

Diederik Aerts

ABSTRACT. We elaborate the new interpretation of quantum theory that we recently proposed, according to which quantum particles are considered conceptual entities mediating between pieces of ordinary matter which are considered to act as memory structures for them. Our aim is to identify what is the equivalent for the human cognitive realm of what physical space-time is for the realm of quantum particles and ordinary matter. For this purpose, we identify the notion of 'story' as the equivalent within the human cognitive realm of what ordinary matter is in the physical quantum realm, and analyze the role played by the logical connectives of disjunction and conjunction with respect to the notion of locality. Similarly to what we have done in earlier investigations on this new quantum interpretation, we use the specific cognitive environment of the World Wide Web to elucidate the comparisons we make between the human cognitive realm and the physical quantum realm.

[1] Diederik Aerts, "La mecànica cuántica y la conceptualidad: Sobre materia, historias, semántica y espacio-tiempo," *Scientiae Studia* 11 (2013), pp. 75-100, doi: 10.1590/S1678-31662013000100004; arXiv:1110.4766 [quant-ph].

INTRODUCTION

The general aim of this article is to continue the elaboration of the new interpretation of quantum mechanics that we presented in Aerts (2009b, 2010a,b). Our focus in this article is to acquire a deeper insight into the similarities and differences between the human cognitive realm and the realm of quantum particles as conceptual entities with respect to the notions of matter and space-time. In previous articles we expressed the view that the human cognitive realm is still much less organized as a conceptual structure than the quantum cognitive realm (Aerts 2009b, Section 4). Our reflections about the notions of matter and space-time attempt to make this difference more concrete and also to identify in more depth still the fundamental similarities.

In our new interpretation of quantum theory (Aerts 2009b, 2010a,b), quantum entities are mediating as conceptual entities between pieces of ordinary matter that function as a memory structure for these quantum entities. By ordinary matter we mean substance made of elementary fermions, i.e., quarks, electrons and neutrinos, hence including all nuclei, atoms, molecules, macroscopic material objects and also measuring apparatuses. Human concepts and combinations of them, i.e., sentences, pieces of text, etc., are mediating between human minds or artificial memories.

Most plausibly due to the billions of years of evolutionary fine-tuning, by means of selection and variation, the quantum mediating cognitive conceptual process has acquired a very deep structural symmetry. This is why it can mathematically be adequately modeled by means of the quantum formalism, as it exists now, which, although quantum theory as a physical theory is very complex, is in essence a relatively simple mathematical structure. In this quantum formalism, states of quantum entities are represented by unit vectors of a complex infinite dimensional Hilbert space, and observables linked to measurement processes are described by self-adjoint operators on this complex Hilbert space. The evolution dynamics is described by Schrödinger equation, or more generally by a unitary transformation of the Hilbert space. The measurement dynamics is described by

orthogonal projection operators of the spectral decomposition of the self-adjoint operator representing the observable to be measured. As a consequence of a measurement, the state is projected and normalized, which in the quantum jargon is called collapse.

The human mediating cognitive process is only thousands of years old, and hence still in a very primitive stage of development as compared to the quantum mediating process. This means that any mathematical theory for the human cognitive realm should be expected to be much more complex than the quantum formalism in a non-trivial way. However, because of the deep ontological correspondence – both are fundamental cognitive processes between memory structures – the quantum formalism can be applied to describe and model quite a number of the effects appearing in human cognition, as has been shown by the numerous results obtained in the newly emerging domain called 'quantum cognition' (Aerts 2009a, Aerts and Aerts 1995, Aerts, Aerts and Gabora 2009, Aerts and Czachor 2004, Aerts and D'Hooghe 2009, Aerts and Gabora 2005a,b, Aerts, Gabora, Sozzo and Veloz 2011, Bruza and Cole 2005, Bruza, Kitto, McEvoy and McEvoy 2008, Bruza, Kitto, Nelson and McEvoy 2009, Busemeyer, Wang and Townsend 2006, Busemeyer, Pothos, Franco and Trueblood 2011, Gabora and Aerts 2002, Khrennikov and Haven 2009, Pothos and Busemeyer 2009, Van Rijsbergen 2004, Widdows 2003, Widdows and Peters 2003). This means that the quantum formalism can certainly serve as a basis for the development of a powerful mathematical formalism for human cognition.

In reflecting on the structure of the human cognitive process that we put forward in this article, we will pay special attention to similarities with the quantum formalism. This involves the risk that, like the quantum structure itself, we may be aiming at a structure that is too simple and concrete already to capture all of the human cognitive process. More in-depth research will therefore need to be conducted in the future than what we are able to present here and have presented in previous articles (Aerts 2009b, 2010a,b). Such research could be inspired by the State Concept Property (SCoP) formalism (Aerts 2002, Aerts and Gabora 2005a,b, Gabora and Aerts 2002) that we developed in

earlier studies of the use of the quantum formalism to model the combination of human concepts.

ABSTRACT, CONCRETE, CONCEPTS AND OBJECTS

There are two parts of analysis regarding the new quantum interpretation that we have performed on previous occasions and that in this article will guide us in identifying the structure that plays the role, with respect to human cognition, that matter and space-time play with respect to the quantum mechanical realm.

The first part of analysis is widely manifest in earlier publications on the new interpretation (Aerts 2009b, Aerts 2010a,b). It is presented in great detail in the analysis of how the Heisenberg's uncertainty relation is encountered in the human cognition realm, in Section 4.1 of Aerts (2009b). The more abstract a human concept is, the less concrete it is, and vice versa, and this is the expression of Heisenberg's uncertainty for the case of human concepts.

For example, the concept *Cat*, without any specification, is a rather abstract concept, whereas if we consider *This Cat Felix*, and we mean 'this particular and unique cat named Felix, the one I can touch and caress with my hand', then this is a most concrete form of the concept *Cat*. On several occasions, we introduced the notion of 'state of a concept'. According to this notion, the most abstract version *Cat* and *This Cat Felix* each represent a state of *Cat*. Hence, for each concept there are states corresponding to more abstract forms of the concept and states corresponding to more concrete forms.

Heisenberg's uncertainty principle for human concepts expresses that a concept cannot be at once in a very concrete and in a very abstract state. This is an expression about the ontological nature of what concepts as mediating entities can be. In our new interpretation of quantum theory, this is also the way Heisenberg's uncertainty principle is explained for quantum entities. A quantum entity cannot be in a very concrete state – a state close to being a localized state – and in a very abstract state – a state close to being a state of definite momentum – at once. On several occasions, we have also introduced the conceptual environment of the World Wide Web to provide examples and

explanations and we will do this again in the present article.

Suppose that we google for the word 'cat'. On September 5, 2011, this returned 2,330,000,000 hits, which means that, on that day, there were 2,330,000,000 webpages listing the word 'cat' at least once. In the conceptual environment of the World Wide Web, the totality of combinations of concepts contained in each of these webpages constitutes also a state of the concept *Cat*, where all other concepts in this combination are conceptual contexts that change the most abstract state of *Cat* to the most concrete state for this specific conceptual environment.

Indeed, the conceptual content of webpages containing the word 'cat' are the most concrete states of *Cat* if we consider the World Wide Web as our specific conceptual environment. Of course, each one of these most concrete states of *Cat* is also a most concrete state of many other concepts, namely the concepts appearing in the text contained in the relevant webpage. It is in this sense that if we focus on the conceptual environment which is the World Wide Web, we may consider the collection of all webpages, more specifically their conceptual content, as the analogue for the case of human concepts of what the content of space is for the case of quantum particles.

More concretely, if one of the webpages is chosen, opened on a computer screen, and looked at by a person, this is the analogue for the case of human concepts of what a snapshot of space and its content, hence localized states of different quantum entities looked at by an observer, is for the case of quantum particles. The current level of order and structure of the collection of webpages of the World Wide Web is far from that of the collection of quantum particles structured in entities of ordinary matter or in fields of bosonic nature, available to appear as a snapshot of localized states in space. On a fundamental level, however, the similarity can be identified.

In quantum theory, a localized state of a quantum particle is complementary to a momentum state, i.e., a state where the momentum of the particle is localized in momentum space, and the Heisenberg's uncertainty principle stands for the incompatibility of both types of state, i.e., for a quantum particle there are no states that are strongly localized in position space and strongly localized in momentum space. The more abstract

the form of a concept, the more it is incompatible with a very concrete form of the same concept. Hence the collection of all abstract forms of human concepts, for example the collection of words in a dictionary, correspond with the snapshots of momentum space and its content.

These abstract forms of concepts are the analogue of quantum particles with well-determined momentum, but almost completely non-localized in position space. Let us take a concrete situation to make this clear. This time we consider the conceptual environment of human memories. The most concrete state of a concept then is the state it has in a specific human memory, where the context is defined by all aspects of this human memory. If two persons communicate with each other by means of the spoken word, then strings of abstract forms of concepts are sent from one human memory to another human memory, triggering these concepts stored in memory, changing their states, or exciting them.

The resulting dynamics is what we refer to as communication between two human minds. When quantum particles emitted by a radiating piece of ordinary matter hit another piece of ordinary matter, atoms or molecules in this piece of matter get excited and, when de-exciting, will send out again quantum particles that can eventually be captured by the original piece of ordinary matter. This is a typical situation of matter interacting with quantum particles, and hence also matter interacting through quantum particles with other matter, or matter communicating with matter.

The second part of analysis is linked to the fundamental difference between a concept and an object. We have reflected about this in several sections of our previous articles, particularly in Section 5 of Aerts (2010b). For a concept A and a concept B, we have that 'A or B' is again a concept. However, if A and B are objects, then 'A or B' is not an object. A 'chair or table' is not an object but a concept. With respect to the logical connective 'and', we do not encounter this fundamental difference between a concept and an object. Indeed, if A and B are concepts, then 'A and B' is a concept, but also if A and B are objects, then 'A and B' is an object. Remark that if A and B are physical objects, hence objects that both occupy a part of physical space, then the object

'*A* and *B*' will occupy both parts of physical space, hence it occupies a part of physical space which is the set theoretic union of the parts of physical space occupied by *A* and *B*, if we consider physical space as a set of points. The foregoing observation contains an important hint with respect to the identification of the human cognition equivalent of what physical space is in the case of quantum particles.

If we consider classical logic and the conceptual combinations which are called propositions, then with respect to such propositions there is a complete mathematical symmetry of the logical connectives 'and' and 'or'. This symmetry is reflected in the set theoretic model of classical logic, where 'and' corresponds to the operation of 'intersection' or 'meet' and 'or' to the operation of 'union' or 'join'. But also in the formation process of human concepts in itself, the connectives 'and' and 'or' play a very symmetric role.

In Aerts (2009a), Section 4.1, we considered this formation process, and we will briefly return to the insight presented there. Through the process of 'concept formation', the two connectives, disjunction and conjunction, play an equally important role. Consider for example the concept *Animal*. *Animal* can be *Dog* or *Cat* or *Horse* or *Rabbit* or… followed by a long list of all the usually known animals. Hence *Animal* is a typical example of a concept where disjunction has played a fundamental role in its formation.

Conjunction can play an equally fundamental role. Consider as an example the concept *Dog*. Then the conceptual combinations *Has Four Legs* and *Likes to Bark* and *Has Fur* and *Likes to Swim* and... followed by a long list of characteristics of a *Dog*, play an essential role in the formation of the concept *Dog*. In the realm where 'objects' are considered, the connective 'or' drops, and we remain with 'and' alone. Also, the connective 'and' has acquired an intense relation with the notion of space as a theatre where 'objects can take place'.

Both parts of analysis – the first, connecting abstraction and concretization with Heisenberg's uncertainty and considering the World Wide Web as an example of a cognitive environment where the most concrete states of concepts are the conceptual contents of webpages where these concepts appear, and the

second, analyzing the fundamental difference between concepts and objects, and how the connectives 'or' and 'and' behave in this respect – are the guide for the hypothesis that we want to put forward in the next section and that will put us on the trail of identifying the equivalence for human cognition of what matter and physical space-time are for quantum particles.

HUMAN COGNITIVE PROTO-MATTER

To identify the equivalent for the human cognitive realm of what physical space-time is for physical reality, we need to investigate first what the equivalent is for the human cognitive realm of what ordinary matter is for physical reality. In previous writings on our new interpretation of quantum theory, we have indicated 'human memory' or 'an artificial memory system capable of interaction with human semantics' as the equivalent for the human cognitive realm of what ordinary matter is for physical reality. In the present article we will elaborate this in more detail.

Following the dual process theory of cognition, two types of human thought are distinguished (Barrett, Tugade and Engle 2004, Bruner 1990, Freud 1899, James 1910, Kahneman 2003, Paivio 2007, Sloman 1996, Sun 2002). Type 1 thought is largely unconscious, automatic, contextual, emotional and speedy. Type 2 thought is deliberate, explicit, effortful and intentional. It turns out that most of human behavior is shaped by the inarticulate type 1 thought.

In earlier work we also identified two modes of thought (Aerts and D'Hooghe 2009) inspired by the mathematical structure of the quantum modeling scheme we developed for human concepts (Aerts 2009a), and called them 'quantum conceptual thought' and 'classical logical thought'. Without doubt there is a correspondence between the two types of thought from dual process theory and the two modes of thought we introduced in Aerts and D'Hooghe (2009). The correspondence, however, is not necessarily a morphism, also because while dual process theory relies on experimental evidence and on theoretical hypothesis related to different aspects of human cognition, our classification finds its origin in the mathematical structure of the quantum modeling scheme.

Roughly, what we have called ‘quantum conceptual thought’ in a comparison would correspond to type 1 thought and what we have called ‘classical logical thought’ would correspond to type 2 thought. We have planned to investigate in depth the nature of this correspondence in future research, but here we will merely use a specific aspect of type 1 thought, which is the following. When a human subject is confronted with a stimulus, it is commonly so that type 1 thought quite spontaneously gives rise to a story or at least a fragment of a story, such that different elements of this stimulus ‘fit the story’. It is this ‘story fitting’ aspects of human type 1 thought that interests us particularly in what follows in this section.

Let us give an example of what we mean. Suppose we consider an experiment where the stimulus consists of words on a screen shown to the participants in the experiments. Consider more specifically the situation where the stimulus is the word ‘bank’. Experiments show indeed that even a stimulus consisting of one word, such as ‘bank’, is enough to give rise to a story for a participant in the experiment, due to type 1 thought. In the case of the word ‘bank’, the story might be about money. Or it can be even more concrete, containing an image of the building of a known bank and a visit to this bank. Or the story can be about a conversation with a staff member of this bank, etc.

We deliberately choose as an example the word ‘bank’, because it is a word with several meanings. Suppose that one of the individuals participating in the experiment is a fervent fisher, then the word ‘bank’ may well evoke ‘the bank he or she sits on while fishing’, giving rise to quite a different type of story. For example, ‘what happened the last time he or she went fishing’, etc. If the stimulus consists of the two words ‘bank’ and ‘money’, it is most likely that only a story containing the first meaning of ‘bank’ is produced, whereas a stimulus consisting of the two words ‘bank’ and ‘fishing’ will most probably trigger only a story containing the second meaning of ‘bank’.

Hence, on presentation of a stimulus consisting of only the word ‘bank’, there may be a very brief instant in which the participant’s mind vacillates between the different meanings and their very different associations. Experiments suggest that such a state of ambiguity rapidly resolves towards one of the two stories

under type 1 thought. If we consider this event within our classification of quantum conceptual thought, we would say that the state of the concept *Bank* collapses to being part of one of the two stories.

Before we give a more specific description of the equivalent for the human cognitive realm of what matter is for physical reality, we want to make a specific observation on ambiguity and stories. We mentioned already that within the process of type 1 thought, in case there is ambiguity about which of the stories will best fit the stimulus data, type 1 thought functions in such a way that the ambiguity is resolved rather quickly, and one of the stories is elected. This means that the connective 'or', if appearing to express ambiguity between two or more stories pertaining to different meanings of the stimulus, is removed by type 1 thought. Of course, we have not explicitly made clear what is meant by 'different meanings of the stimulus'. However, what we want to show in the following is that the choice within type 1 thought to optimize the removal of ambiguity, has a deep influence on the nature of the stories that we allow as entities. Let us make this more concrete.

If we consider one story *A* and a second story *B*, then the story '*A* and *B*' is again a story. In an extreme case, when there is no meaningful connection between *A* and *B*, the new story '*A* and *B*' is nothing more than two separated stories *A* and *B*, but this we still consider as a story, albeit of an extreme type. In most cases, however, there will spontaneously emerge meaningful connections between *A* and *B*, such that '*A* and *B*' is a new story which is more than the two stories *A* and *B* separately. Indeed, it would be rare for two stories *A* and *B* not to contain meaningful connections in any individual's life such that they merge spontaneously to a third story '*A* and *B*'.

For two stories *A* and *B*, the cognitive construction '*A* or *B*' is usually not considered to be a story. Looked at from a purely conceptual point of view – i.e., if we consider a story just as a combination of concepts – then '*A* or *B*' is again a combination of concepts, and hence again a story. But if we put the connective 'or' between two stories, although in theory this gives rise to a story, it will usually not be considered as a story, because the ambiguity is introduced in an artificial way, so that its reduction

is not optimized, taking into account the global meaning landscape of the human mind involved.

Let us go back to the example of the stimulus 'bank'. It is very well possible that this stimulus gives rise to ambiguity in the mind of a participant in the experiment, invoking a story consisting of '*A* or *B*' – where in story *A*, the word 'bank' is associated with 'money', and in story *B*, with a place where you can 'sit'. But if such ambiguity appears in the '*A* or *B*' story, it will be considered 'an ambiguity to be removed', which is why '*A* or *B*' will usually not be considered a story.

On many occasions, we have taken the World Wide Web as a possible cognitive environment, primarily because it allowed us to collect experimental data, by making use of search engines (Aerts 2009b, Aerts 2010a,b, Aerts 2011, Aerts, Czachor, D'Hooghe and Sozzo 2010). We will take the same approach in this article, and this time the webpages will play the role of what we have called stories. Using the Yahoo search engine, let us show how indeed the connectives 'and' and 'or' play different roles in webpages of the World Wide Web.

On September 15, 2011, we found the word 'and' to return 1,610,000,000 Yahoo hits, and the word 'or' to return 5,400,000,000 Yahoo hits. This means that 'or' appears more often than 'and' on the World Wide Web, although both frequencies of appearance are of the same order of magnitude, and their proportion is 1,610,000,000/5,400,000,000 = 0.3.

We then elected two words that had no obvious connection, viz. the words 'car' and 'building'. The number of Yahoo hits for 'car and building' was 8,450, and the number of Yahoo hits for 'car or building' was 7,810 – we carried out searches for the appearance of the expressions 'car and building' and 'car or building' in their entirety, hence by entering double quotation marks on both sides of the expression in a Yahoo search engine. To compare these frequencies of appearance systematically, let us introduce:

$$C(\text{car} \ldots \text{building}) = \frac{N(\text{car and building})}{N(\text{car or building})}$$

where $N(\text{car and building})$ is the number of webpages

containing the part of sentence 'car and building' and $N(\text{car or building})$ is the number of webpages containing the part of sentence 'car or building'. Hence, we have:

$$C(\text{car} \ldots \text{building}) = \frac{8{,}450}{7{,}810} = 1.08$$

If we use longer combinations that carry more meaning, such as 'the car and the building', we get 2,950 Yahoo hits, while 'the car or the building' returns 33 hits, which means that the proportion has increased to 89; indeed we have:

$$C(\text{the car} \ldots \text{the building}) = \frac{2{,}950}{33} = 89$$

We consider a second example using the two words 'flute' and 'bass'. We have 'flute and bass' giving rise to 11,900 Yahoo hits, while 'flute or bass' gives rise to 162, hence a proportion of 73.4. If we look at a longer part of sentence including the two words 'flute' and 'bass', we find for 'the flute and the bass', 68 Yahoo hits, and for 'the flute or the bass', 1 Yahoo hit, hence a proportion of 68.

For the next example, we consider the two words 'horse' and 'house'. For the part of sentence 'horse and house' we find 12,500 Yahoo hits, and for the part of sentence 'horse or house' we find 4,690 Yahoo hits, hence a proportion of 2.6. The longer part of sentence 'the horse and the house' gives rise to 73 Yahoo hits, while 'the horse or the house' gives rise to 5 Yahoo hits, hence a proportion of 14.6. Table 1 presents the different examples and their respective proportions, and we will analyze the results in the following.

It should be noted that the World Wide Web is still far too small to provide significant statistics for longer parts of sentences than the ones we have considered. Indeed, a part of sentence such as 'the red car and the high building' already returns zero hits, as does the part of sentence 'the red car or the high building'. However, we predict that once the World Wide Web has grown to the extent that searches for long sentences, and eventually even paragraphs, return substantial numbers of pages containing these

longer sentences or paragraphs, the proportion between the connective ‘and’ and the connective ‘or’ will increase for long parts of combinations of concepts, when the combinations are made with concepts chosen without obvious connection.

expression	‘and’ hits	‘or’ hits	proportion
	1,610,000,000	5,400,000,000	0.3
car ... building	8,450	7,810	1.1
the car ... the building	2,950	33	89.4
flute ... bass	11,900	162	73.4
the flute ... the bass	68	1	68
horse ... house	12,500	4,690	2.6
the horse ... the house	73	5	14.6
table ... sun	8,900	123	72.4
the table ... the sun	83	3	27.7
window ... door	4,090,000	937,00	4.3
the window ... the door	9,000	21,900	0.4
the window ... door	61,900	22,800	2.7
laugh ... cry	297,000	779,000	0.4
to laugh ... to cry	11,100	11,400	1
to laugh ... cry	31,400	311,000	0.1
dead ... alive	149,000	13,100,000	0.01
being dead ... alive	3,270	9,010	0.3
wanted dead ... alive	47,100	2,240,000	0.02
coffee ... tea	2,860,000	3,690,000	0.7
drinking coffee ... tea	8,580	26,800	0.3
wants coffee ... tea	2	92	0.02
want coffee ... tea	51	8,230	0.006
milk ... sugar	1,510,000	24,600	61.3
wants milk ... sugar	10	4	2.5
want milk ... sugar	141	179	0.8

Table 1. A systematic comparison between the frequency of appearance of the connectives ‘and’ and ‘or’.

However, if the occurrence of ‘and’ as a connective in sentences is more frequent than that of ‘or’, why are there three to four times more single ‘or’ connectives than ‘and’ connectives, the numbers of Yahoo hits being 1,610,000,000 for the connective ‘and’ and 5,400,000,000 for the connective ‘or’? Could it be that

there is a mistake in how Yahoo counts these pages? There is not, and the following examples explain why. Indeed, the state of affairs that we are bound to detect and that explains why there is no mistake, will also lead us to the identification of the proto structure of matter within the human conceptual realm.

So, for the next example, we will consider the two words 'window' and 'door'. For 'window and door' and 'window or door', we find 4,090,000 hits and 937,000 hits, respectively, hence a proportion of 4.3, still an increased frequency of the connective 'and' as compared to the connective 'or'. Next, we consider the part of sentence 'the window and the door', which gives 9,000 hits, while the part of sentence 'the window or the door' gives 21,900 hits. This suddenly inverses the proportion, i.e., for this part of sentence, the frequency of the connective 'or' is higher than that of the connective 'and'. The proportion of 'and' to 'or' is 0.4.

Let us try to understand this phenomenon by looking at some specific webpages that appear in the Yahoo search. For example, when searching for the part of sentence 'the window or the door', we found webpages where it appeared in the phrase: 'Do you prefer your bed facing the window or the door to your room?', and in: 'Easily mounted by adhesive tape to the window or the door', and again in: 'But Holmes credits himself for quickly adapting and revising his theory once he was personally convinced that no danger could enter the room from the window or the door'.

When we searched for the part of sentence, 'the window and the door', we found that the first webpages all contained the sentence 'Hidden behind the window and the door', followed by several webpages containing the sentence 'Close the window and the door'. The inversion of the proportion means that the part of sentence 'the window or the door' is more frequent in the meaning structure of human cognition than the piece of sentence 'the window and the door'. There is another aspect we need to point out. Let us consider the part of text 'the window and door', for which Yahoo gives 61,900 hits, against 22,800 hits for 'the window or door'. This means that for these very similar parts of text the proportion between 'and' and 'or' is normalized again, namely 2.7. In short, it is for the parts of text

'the window and the door' and 'the window or the door' that the inversion takes place.

Let us examine another example to understand better this phenomenon. We considered the two words 'laugh' and 'cry'. For the parts of text 'laugh and cry' and 'laugh or cry', we found 297,000 and 779,000 Yahoo hits, respectively, which means again an inversion of the same order of magnitude as the one we identified for 'window' and 'door', i.e. 0.4. We then considered the parts of text 'to laugh and to cry', which yielded 11,100 hits, and 'to laugh or to cry', giving 11,400 hits, i.e., a proportion equal to 1. This means that the inversion disappeared again. Lastly, we considered the parts of text 'to laugh and cry', with 31,400 Yahoo hits, and 'to laugh or cry', with 311,000 Yahoo hits, giving a proportion of 0.1, which indicates a very strong supremacy of the connective 'or' over the connective 'and' for this part of sentence.

Hence, in the case of 'window' and 'door', it is the specific part of sentence 'the window or the door' which introduces a strong weight with respect to the appearance of the ambiguity connected to the connective 'or', while in the case of 'laugh' and 'cry', it is the specific part of sentence 'laugh or cry' which introduces a strong weight with respect to this ambiguity introduced by the connective 'or'.

Let us consider a third example, namely the combinations of the two substantives 'dead' and 'alive' using the connectives 'and' and 'or'. The combinations are 'dead and alive', with 149,000 hits, and 'dead or alive', with 13,100,000 hits, hence a proportion of 0.01, which is one tenth of what we found earlier. Here, the inversion is enormous. For 'being dead and alive' we found 3,270 hits, and for 'being dead or alive', we found 9,010 hits. This means that the effect of inversion almost disappeared when the combination of concepts 'dead or alive' was entered in the part of text including the concept 'being' in front, the proportion being 0.3. But if we consider 'wanted dead and alive', with 47,100 hits, and 'wanted dead or alive', with 2,240,000, the proportion is 0.02, which is again of the order of magnitude of the expression itself.

The next example concerns the words 'coffee' and 'tea'. For 'coffee and tea', we found 2,860,000 hits, and for 'coffee or

tea', we found 3,690,000 hits, i.e., a proportion of 0.7. When we put the word 'drinking' in front, however, the change was substantial. We found that 'drinking coffee and tea' returned 8,580 hits, against 26,800 hits for 'drinking coffee or tea', hence a proportion of 0.3. We then tried several more combinations. We entered 'wants coffee and tea', with 2 hits, and 'wants coffee or tea' with 92 hits, a proportion of 0.02, which is the order of magnitude we found for 'dead' and 'alive'. We also entered 'want coffee and tea', with 51 hits, and 'want coffee or tea', with 8,230 hits, a proportion of 0.006, the smallest we had found so far.

Our final example considers the words 'milk' and 'sugar'. For 'milk and sugar', we found 1,510,000 hits, and for 'milk or sugar', we found 24,600 hits, i.e., a proportion of 61.3, the order of magnitude of the biggest results we found so far. Furthermore, we searched for 'wants milk and sugar', with 10 hits, and 'wants milk or sugar', with 4 hits, hence a proportion of 2.5. For 'want milk and sugar', the number of hits was 141, and for 'want milk or sugar', the number of hits was 179, hence a proportion of 0.8.

When we combine two concepts that we have chosen more or less at random, such as *Car* and *Building*, *Flute* and *Bass*, *Horse* and *House*, and *Table* and *Sun*, Yahoo searches of the corresponding words 'car' and 'building', 'flute' and 'bass', 'horse' and 'house', and 'table' and 'sun' on the World Wide Web, indicate that combinations with the connective *And* in between these concepts are more common than combinations with the connective *Or*. The connective *Or* introduces an abstraction and, taking into account our identification of the Heisenberg's uncertainty as related to abstraction and concretization (Aerts 2009b, section 4.1), this means that where the connective *Or* is substituted in between two concepts (Aerts 2009b), a superposition state is formed, which is less localized than the two component states.

On the contrary, in general, the connective *And* introduces a concretization. This means that where the connective *And* is substituted in between two concepts, a pure state which is more localized is formed. Since our experimentation with the World Wide Web shows that, for randomly chosen concepts, the longer the combination, the more common the *And* connective becomes

as compared to the *Or* connective, this indicates the general tendency towards localization of texts to be found on webpages of the World Wide Web. This process towards localization stops per definition at the cognitive end-products, which are the concrete webpages contained in the World Wide Web. If we take the World Wide Web as an example of a cognitive environment, it is these concrete webpages that are the equivalents for human cognition of what ordinary matter is for physical reality.

Within a classical vision on physical reality, it is believed that matter fills up space-time by giving rise to objects. In previous articles, e.g., Aerts (2009b), Section 4.3, we already analyzed why this classical vision is the limit of a process towards objectivation, where, however, the status of object as such is never reached. The notion of object is therefore only an idealized notion playing a valuable role in the idealized theory which classical physics is. This is borne out by physical ordinary matter, which is never really localized, because it contains atoms and molecules, and inside of these substructures, particles are in superposition states which are not local.

Hence, we encounter a similar situation explicitly in the realm of human cognition. The *Or* connective, giving rise to non-localized states, consistently appears in large numbers in the form of small 'molecules of meaning' in the webpages of the World Wide Web. The examples we identified are *The Window Or The Door*, *Laugh Or Cry*, *Dead Or Alive* and *Coffee Or Tea*. These are the equivalents for the human cognitive realm of what the molecules and atoms of ordinary matter are for physical reality.

There is another thing we wish to point out. At first sight, it might seem that the molecules of meaning of the human cognitive realm are immobile, as if nothing moves inside them, in apparent contrast with the highly dynamic nature of atoms and molecules of ordinary matter, with electrons moving around nuclei made up of protons and neutrons. First of all, the idea of 'electrons moving around a nucleus', something like a miniature solar system, is an image that we know to be very wrong. It is an image that, again, is forced upon us because quantum particles are presented as tiny ping pong balls bumping and bouncing around (Aerts 2010b).

Most text books on quantum physics state rather explicitly that

the image of the tiny solar system is wrong, because the electrons 'move in a cloud around the nucleus'. Although this is supposed to rectify the prevailing erroneous idea of quantum particles, the resulting image is very wrong yet again. There is nothing that really moves within a molecule or an atom. One step towards a better definition would be to say that 'the electrons are in a cloud around the nucleus', and that 'this cloud changes as time elapses'. Of course, the expression 'as time elapses' should also be specified with care. It actually means 'as time elapses when measured in a laboratory where experiments are performed with molecules and atoms'.

With respect to this time, the cloud of presence of the electrons changes. And even this is not correct. It is not 'a cloud of presence', but 'a cloud of potential presence'. And, if we add the word 'potential', the word 'cloud' is in fact no longer correct. In short, the following statement would be much closer to being correct: 'Electrons are in states of potential presence, and this presence – which is 'not' actualized in general – is situated around the nucleus. And it is the potential which changes as time in the laboratory elapses'.

Let us consider the molecule of human cognition, 'coffee or tea'. The typical situation that we can imagine with respect to this molecule of human cognition is the following. At a reception for a specific event, coffee and tea are served. One of the visitors of the event is presented a tray with cups of hot coffee and cups of hot tea, with the person holding the tray uttering the words 'coffee or tea'. Let us now zoom in on the mind of the visitor, who likes both of the drinks offered. Before making a choice, the visitor is most likely to see the different alternatives pass before his or her eyes. Literally, this means that the potentialities with respect to the coffee versus tea choice are changing as the time within visitor's mind elapses.

This 'change of potentialities of the coffee or tea alternative' is the equivalent for the human cognitive realm of the change taking place in a molecule in physical reality. It is one of the research aims of our Brussels' group to work out a concrete model for this, but, most of all due to so many other fascinating research aims we are working on at the moment, we have not yet had the opportunity to do so in very explicit terms. Over a decade

ago, however, we succeeded in elaborating a model of change within the human cognitive realm, more specifically for the situation of the liar paradox (Aerts, Broekaert and Smets 1999a,b), and the approach and method used for this dynamical model of the liar paradox can readily be used for a description of the dynamics of the 'coffee or tea' cognitive molecule. Something of this nature was done, for example, for the situation of the Prisoner's Dilemma situation by Jerome Busemeyer and collaborators (Busemeyer, Wang and Townsend 2006, Busemeyer, Pothos, Franco and Trueblood 2011, Pothos and Busemeyer 2009).

HUMAN COGNITIVE REALITY AND PHYSICAL SPACE-TIME

Physical space-time is the theatre of ordinary matter. More specifically, it is the imagined place and time where snapshots filled with ordinary matter interacting with quantum particles can be situated. Hence, the equivalent of this physical space-time for the human cognitive realm is the theatre of stories.

It is, by the way, interesting to remark that the word 'story' is derived from the Latin 'historia' and the Greek '*ιστορια*', which in turn is derived from the Proto-Indo-European root 'weid-'. This root has given rise to the following derivations in different languages: English 'ywis', English 'iwis', English 'wise', English 'wisdom', English 'witan', English 'wite', French 'guise', Greek 'eidos', Greek 'Haides', Greek 'histor', Irish 'find', Latin 'videre', Provencal 'guidar', Sanskrit 'vedah'.

How and where can stories be situated? Again, the example of the World Wide Web can help us to gain a better insight into the structure that reveals itself by identifying stories as the equivalent for human cognition of ordinary matter for physical reality. If we consider each webpage, or interconnected website, as a story, the collection of all stories then becomes the collection of all webpages, which is the World Wide Web. Can we identify a space-time like structure connected to the World Wide Web? It is quite obvious that no space-time like structure very similar to physical space-time can be identified connected to the World Wide Web. But then, there is no need for that, because, like we mentioned already, we expect the structures connected to the

human cognitive realm to be much more complex than the equivalent structures connected to the quantum realm. And there is a whole body of scientific research that is of value with respect to this question, even from before the World Wide Web existed.

Indeed, scientists have extensively studied the semantic structure of large bodies of texts, and also proposed mathematical models for it, called 'semantic spaces'. The core of most of these semantic analysis approaches is the so-called 'document-term matrix', which contains as entries the number of times that a specific term appears in a specific document. Suppose that we label the rows of the matrix by the documents and the columns by the terms, then each row of the matrix can be seen as a vector representing the corresponding document, and each column as a vector representing the corresponding term. If vectors are normalized, the scalar product amongst such normalized vectors is a measure of the similarity of the corresponding documents and terms, and it is also used as such in theories of Information Retrieval and Semantic Analysis.

In the vector space of vectors representing terms, the documents are represented by the canonical base vectors of this vector space. This means that also the similarity between terms and documents can be calculated by means of the scalar product of the corresponding vectors, and in this way documents can be compared with search terms, and the most relevant documents can be taken to be the most similar ones. This is more or less how today's search engines on the World Wide Web work, although in practice there are many variations on this basic approach. Vector space models for Semantic Analysis and Information Retrieval were first introduced by Salton, Wong and Yang (1975). Recent examples of such approaches are Latent Semantic Analysis (LSA) (Deerwester et al. 1990), Hyperspace Analogue to Language (HAL) (Lund and Burgess 1996), Probabilistic Latent Semantic Analysis (pLSA) (Hofmann 1999), Latent Dirichlet Allocation (Blei, Ng and Jordan 2003), or Word Association Space (WAS) (Griths and Steyvers 2002). Connections with quantum structures have been investigated from different perspectives within the previously mentioned emergent domain of research called 'Quantum Cognition' (Aerts and Czachor 2004, Arafat and van Rijsbergen 2007, Van

Rijsbergen 2004, Widdows 2003, 2006, 2008, 2009, Widdows and Peters 2003).

Let us have a closer look at LSA (Deerwester et al. 1990), for which we analyzed correspondences with quantum physics in Aerts and Czachor (2004). LSA explicitly introduces rank lowering of the document-term matrix by considering the singular value decomposition of this matrix and substituting some of the lower singular values by zero. One reason for introducing this rank lowering technique is to render the sparse matrix of very high rank into a less sparse matrix of less high rank, which makes it easier to manipulate from a mathematical point of view. There is also an effect of de-noisification, since the original document-term matrix is noisy due to the presence of anecdotal instances of terms.

However, there are two more subtle aspects that are of specific interest to our analysis. If some of the lower singular values are substituted by zero, and the approximated document-term matrix is calculated, it can be shown that the places where the original document-term matrix had zeros, because the terms did not appear in the document, will now contain numbers different from zero. This means that the new document-term matrix reveals 'latent' connections between documents and terms. Even if a term does not appear in a specific document, but does appear in many documents similar to this document, the matrix will contain a number different from zero for this term and this document, expressing that, although the term does not appear in the document, it is relevant for the document.

Another aspect is that the terms of the square matrix appearing after the singular value decomposition can be interpreted as 'conceptual dimensions'. These terms indeed correspond in some way to 'directions of strong relationships between the terms and documents', and if we express these directions conceptually, they can be interpreted as 'conceptual dimensions'. Even analyses of small samples using the LSA technique may produce high numbers of these dimensions. This is an expression of what we mentioned already, namely that the human cognitive realm is still much less organized than physical reality, where quantum particles interact with ordinary matter. For this realm of physical reality, three space dimensions have shown to be able to grasp all

of the structure, at least on the macroscopic level.

To date, LSA has proved one of the most powerful semantic analysis formalisms. The procedures are fully automatic and allow to have texts analyzed by computers without any involvement of human understanding. LSA produced particularly impressive results in experiments with simulation of human performance. LSA-programmed machines were able to pass multiple-choice exams such as a Test of English as a Foreign Language (TOEFL) (after training on general English) (Landauer and Dumais 1997) or, after learning from an introductory psychology textbook, a final exam for psychology students (Landauer, Foltz and Laham 1998).

LSA certainly owes much of its potential to its ability to calculate the similarity between a term and a document without the need for the term to appear in the document. The mathematical technique penetrates the meaning structure which is at the origin of the texts to be found in the documents, which are only snapshots of this meaning structure. Hence, by introducing a non-operational mathematical ingredient, the lowering of dimension by means of singular value decomposition and dropping of lower singular values, the LSA approach manages to introduce a mathematical description that is a better model of the underlying meaning structure.

Since the World Wide Web is a large collection of texts, the semantic space approaches can also be applied directly to it, which is what search engines do. If words are typed into a search engine, the pages of the World Wide Web which are ‘closest’ to these words are gathered and presented to the individual that is doing the search. How the notion of ‘closest’ is calculated depends on the type of semantic space taken as a foundation of the Web search engine, and possibly on other aspects of relevance. Anyhow, ‘closest’, and hence also ‘close’, ‘less close’, ‘further away’, ‘far away’ and ‘farthest’ are estimations that can be calculated numerically within such a semantic space model of the World Wide Web, and they are always linked to ‘meaning’. It is possible to define a ‘meaning bond’ directly on the World Wide Web (Aerts 2011), and identify aspects of concept combinations such as the ‘guppy effect’ by using this meaning bond (Aerts, Czachor, D’Hooghe and Sozzo 2010).

Even less so than is the case for the World Wide Web or other large bodies of text, the collection of human stories as the proto-matter of human cognition will have an easily identifiable semantic structure, although some of the problems encountered for the World Wide Web or other large bodies of text are not, or at least less, present for the collection of human stories. For example, unlike human minds, search engines need to work with 'words' and cannot directly work with 'concepts'. Equally so, a story is different from a collection of words in that it is also a conceptual entity. Hence, to develop the mathematical structure of human cognition, it is possible to focus on 'concepts' rather than on 'words', and on 'the conceptual entities that stories are' rather than on 'the bag of words that a webpage is'.

Although it is a very important and intriguing problem to find out what is the most adequate topological and/or metric structure of meaning within the realm of human cognition, hence how concepts and stories can be mathematically represented such that their intrinsic connections are modeled, in the next part of this section we want to focus on the global insights into physical reality we can infer from our identification of the equivalent for human cognition of what ordinary matter and physical space is for human cognition. Indeed, independently of the topological and/or metric structures, structural elements can be identified on a more profound level.

Let us again consider the World Wide Web as our working example. We will also make use of the operational analysis we have elaborated for space-time and relativity in earlier work (Aerts 1996a,b, 1999). This analysis carefully distinguishes between the different elements that are underlying the reality of space-time, taking into account the insights gained through operational quantum theory within the Geneva-Brussels approach (Piron 1976, 1990, Aerts 1982, 1983), and hence introducing explicitly a role for 'the effect of measurement' and 'the construction aspect of elements of reality' also in relativity theory. The main elements of this operational analysis are the following.

We consider the following situation. An observer O_1 has a specific experience e_1, which is his or her 'present experience'

at a particular moment of time, which we call t_1, measured by his or her watch. This 'present experience' contains only a tiny part of the reality that exists at this moment t_1 for this observer. How can we know in an operational way what is the rest of the existing reality at moment t_1 for this observer O_1? We propose the following operational procedure, borrowed from quantum theory.

At some moment in the observer's past, he or she could have made a decision such that his or her present experience, hence the experience at time t_1, is different from e_1, for example e'_1. Also, the part of reality contained in experience e'_1 exists for the observer at time t_1. At another moment in the observer's past, yet another decision could have been made leading up to a third experience e''_1 at time t_1. Also the reality contained in this third potential experience e''_1 exists at time t_1 for the observer. Hence, if we call $\mathcal{E}$ the set of all potential experiences that the observer could have lived at time t_1, if he or she would have made decisions in the past leading to one of these experiences, then the reality contained in each one of these experiences exists at time t_1 for the considered observer O_1.

In Aerts (1996a,b), we showed that if relativity theory is interpreted geometrically, namely that the length contraction and time dilation effects calculated in relativity theory are real space-time shifts and not physical effects on rods and clocks, future events in some reference frame are contained in the present reality at time t_1 of the observer O_1 that we consider. The reason is that the considered observer could have decided in the past to go and travel close to the speed of light so that, on his or her return, time on earth would have elapsed much more than the time indicated on the observer's watch. This means that at time t_1 future events in earth time are real for the observer. Hence, reality is four-dimensional, containing, in addition to the three dimensions of space, also a dimension that reaches out into the future in this specific way.

We analyzed this situation in detail in Aerts (1996a,b), and refer to these articles for the subtleties involved. Although the analysis presented in these earlier papers proves that there is no paradox involved, it still is a situation that is difficult to grasp, of

course. We will now show that our new interpretation of quantum mechanics sheds new light on this situation too.

Let us once more consider the World Wide Web as a cognitive environment of the human cognitive realm, and analyze the reality-time structure that emerges. Observing, now consists in electing a webpage of the World Wide Web and reading this webpage. Let us consider an observer O_1. We start by considering experience e_1 taking place at time t_1 on the observer's watch, while the experience consists of electing website w_1 and reading it. The reality contained in this present experience is webpage w_1, more specifically the meaning content of webpage w_1. But in the observer's past, he or she could have made another decision, such that at time t_1 another webpage w'_1 would have been elected, and the experience e'_1 would take place, consisting in electing this webpage w'_1 and reading it. This means that also the meaning content of webpage w'_1 is part of the reality of observer O_1 at time t_1.

The same line of reasoning can be followed for all webpages that can be elected and consulted by the observer. Let us make the hypothesis that all existing webpages are available to be elected by an observer. Hence, as a consequence the semantic content of the collection of all existing webpages is the reality at time t_1 for this observer O_1. This conclusion still fairly well corresponds to what we would intuitively think to be the 'semantic reality' at time t_1 of the observer O_1, since he or she can, if he or she wants to, indeed elect and consult any of the existing webpages.

Let us consider a second observer O_2. For the first observer O_1, the semantic content of all webpages is 'real' at time t_1, 'because' he or she could elect any of this content and experience it at time t_1. For a second observer O_2, we can follow an equivalent line of reasoning, and hence as a consequence the semantic content of all of the webpages is real at time t_2 for this observer, where t_2 is a time measured on the watch of the second observer O_2. This means that for both observers O_1 and O_2, the whole semantic content of the World Wide Web is their reality at any moment of time on their respective watches. Whenever they act by making a part of this global semantic content of the

whole World Wide Web into their present experience, they elect a parcel of place-time reality and the stories contained in it in the human cognitive realm. By 'place-time' we mean 'semantic place' and time, where the semantic place is defined by a semantic theory, for example one of the semantic spaces we mentioned in the foregoing section.

Let us apply the insight gained in the above to physical reality and physical space-time. Hence, we start from the basic hypothesis of our new quantum interpretation, namely that, fundamentally, in the realm of the physical reality of ordinary matter interacting with quantum particles a similar state of affairs exists as in a process which is a conceptual communication process. If this hypothesis is true, the role that the observer played in our foregoing analysis within the human cognitive realm is now played by pieces of ordinary matter within the realm of physical reality.

These pieces of matter communicate with each other by means of quantum particles. In the course of these communication processes, place-times are elected where these processes 'take place (and time)'. Of course, since our human body is itself such a piece of matter, it participates in these processes whenever we as humans and as physical entities are confronted with these processes of communication between pieces of matter through quantum particles. To avoid any confusion, it should be noted that here we 'do not' participate with our human minds in the human cognitive realm. Or again, 'we do not speak with these material entities'. Although we see them, i.e., participate in these processes by means of photons, we do not speak with them. This is why, to our human mind, which is an entity interacting in the human cognitive realm, this communication happening in the physical realm is interpreted as 'the experiencing of snapshots of space-time filled with objects made of matter'. This is a wrong interpretation. We imaginarily paste together all these snapshots of space-time to a space-time continuum and picture for ourselves the situation as if pieces of matter were moving around in this space-time continuum as material objects.

This erroneous interpretation originated classical mechanics and it was not until the advent of quantum theory that its faulty nature could be pointed out. Let us remark that relativistic effects

such as time dilation can be naturally explained by the analysis presented in this article. Indeed, there is no space-time filled with objects consisting of matter. On the contrary, it is matter interacting with other matter through quantum particles that time and again locally gives rise to a place-time parcel, i.e., a space-time snapshot. Exactly like – to return to the realm of human cognition – the webpage elected at a certain time gives rise to the place-time parcel, this time within semantic space, where the semantic interaction can be localized.

The reason why the locally brought about space-time snapshots hang together to form a relatively smooth global space-time continuum for the global reality is because all these local snapshots are indeed grounded in one reality, which, however, is not inside a space-time. Again, we can understand this phenomenon by comparing it with how it happens in the human cognitive realm. All the locally elected webpages hang together such that they can be looked at as forming a relatively smooth global body of text, because all of them are grounded in one reality, namely the reality of global human knowledge.

REFERENCES

Aerts, D. (1982). Description of many physical entities without the paradoxes encountered in quantum mechanics. *Foundations of Physics* 12, pp. 1131–1170.

Aerts, D. (1983). Classical-theories and non-classical theories as a special case of a more general theory. *Journal of Mathematical Physics* 24, pp. 2441–2453.

Aerts, D. (1996a). Framework for possible unification of quantum and relativity theories. *International Journal of Theoretical Physics* 35, pp. 2399–2416.

Aerts, D. (1996b). Relativity theory: what is reality? *Foundations of Physics* 26, pp. 1627–1644.

Aerts, D. (1999). The stuff the world is made of: physics and reality. In: D. Aerts, J. Broekaert and E. Mathijs (Eds.), *Einstein meets Magritte: An Interdisciplinary Reflection* (pp. 129–183). Dordrecht: Springer.

Aerts, D. (2002). Being and change: foundations of a realistic operational formalism. In: D. Aerts, M. Czachor and T. Durt (Eds.),

Probing the Structure of Quantum Mechanics: Nonlinearity, Nonlocality, Probability and Axiomatics (pp. 71–110). Singapore: World Scientific.

Aerts, D. (2009a). Quantum structure in cognition. *Journal of Mathematical Psychology* 53, pp. 314–348.

Aerts, D. (2009b). Quantum particles as conceptual entities: A possible explanatory framework for quantum theory. *Foundations of Science* 14, pp. 361–411.

Aerts, D. (2010a). Interpreting quantum particles as conceptual entities. *International Journal of Theoretical Physics* 49, pp. 2950–2970.

Aerts, D. (2010b). A potentiality and conceptuality interpretation of quantum physics. *Philosophica* 83, pp. 15–52.

Aerts, D. (2011). Measuring meaning on the World Wide Web. In: D. Aerts, J. Broekaert, B. D'Hooghe and N. Note (Eds.), *Worldviews, Science and Us: Bridging Knowledge and Its Implications for Our Perspectives of the World. Singapore*. World Scientific.

Aerts, D. and Aerts, S. (1995). Applications of quantum statistics in psychological studies of decision processes. *Foundations of Science* 1, pp. 85–97.

Aerts, D., Aerts, S. and Gabora, L. (2009). Experimental evidence for quantum structure in cognition. In P. D. Bruza, D. Sofge, W. Lawless, C. J. van Rijsbergen and M. Klusch (Eds.), *Proceedings of QI 2009-Third International Symposium on Quantum Interaction*, Book series: Lecture Notes in Computer Science, 5494, pp. 59–70. Berlin, Heidelberg: Springer.

Aerts, D., Broekaert, J. and Smets, S. (1999a). The liar paradox in a quantum mechanical perspective. *Foundations of Science* 4, pp. 115–132.

Aerts, D., Broekaert, J. and Smets, S. (1999b). A quantum structure description of the liar paradox. *International Journal of Theoretical Physics* 38, pp. 3231–3239.

Aerts, D. and D'Hooghe, B. (2009). Classical logical versus quantum conceptual thought: Examples in economics, decision theory and concept theory. In: P. D. Bruza, D. Sofge, W. Lawless, C. J. van Rijsbergen and M. Klusch (Eds.), *Proceedings of QI 2009-Third International Symposium on Quantum Interaction*, Book series: Lecture Notes in Computer Science, 5494, pp. 128–142.

Aerts, D. and Czachor, M. (2004). Quantum aspects of semantic analysis and symbolic artificial intelligence. *Journal of Physics A-Mathematical and General* 37, L123–L32.

Aerts, D., Czachor, M., D'Hooghe, B. and Sozzo, S. (2010). The Pet-Fish problem on the World Wide Web. *Proceedings of the AAAI Fall Symposium (FS-10-08), Quantum Informatics for Cognitive, Social, and Semantic Processes*, pp. 17–21.

Aerts, D. and Gabora, L. (2005a). A theory of concepts and their combinations I: The structure of the sets of contexts and properties. *Kybernetes* 34, pp. 167–191.

Aerts, D. and Gabora, L. (2005b). A theory of concepts and their combinations II: A Hilbert space representation. *Kybernetes* 34, pp. 192–221.

Aerts, D., Gabora, L., Sozzo, S. and Veloz, T. (2011). Quantum interaction approach in cognition, artificial intelligence and robotics. In: *Proceedings of the Fifth International Conference on Quantum, Nano and Micro Technologies* (ICQNM 2011), Nice, France, August 21–27, 2011.

Arafat, S. and van Rijsbergen, C. J. (2007). Quantum theory and the nature of search. *Proceedings of the AAAI Quantum Interaction Symposium*, pp. 114–122.

Barrett, L. F., Tugade, M. M. and Engle, R. W. (2004). Individual differences in working memory capacity and dual-process theories of the mind. *Psychological Bulletin* 130, pp. 553–573.

Blei, D. M., Ng, A. N. and Jordan, M. I. (2003). Latent Dirichlet Allocation. *Journal of Machine Learning Research* 3, pp. 993–1022.

Bruner, J. (1990). *Acts of Meaning*. Cambridge, MA: Harvard University Press.

Bruza, P. D. and Cole, R. J. (2005). Quantum logic of semantic space: An explanatory investigation of context effects in practical reasoning. In: S. Artemov, H. Barringer, A. S. d'Avila Garcez, L. C. Lamb and J. Woods (Eds.), *We Will Show Them: Essays in Honour of Dob Gabbay*. London: College Publications.

Bruza, P. D., Kitto, K., McEvoy, D. and McEvoy, C. (2008). Entangling words and meaning. In: *Proceedings of the Second Quantum Interaction Symposium*, Oxford, UK, Oxford University Press, pp. 118–124.

Bruza, P. D., Kitto, K., Nelson, D. and McEvoy, C. (2009). Extracting spooky-activation-at-a-distance from considerations of entanglement. In: P. D. Bruza, D. Sofge, W. Lawless, C. J. van Rijsbergen and M. Klusch, (Eds.), *Proceedings of QI 2009-Third International Symposium on Quantum Interaction*, Lecture Notes in Computer Science, 5494, Berlin, Heidelberg: Springer, pp. 71–83.

Busemeyer, J. R., Wang, Z. and Townsend, J. T. (2006). Quantum dynamics of human decision-making. *Journal of Mathematical Psychology* 50, pp. 220–241.

Busemeyer, J. R., Pothos, E., Franco, R. and Trueblood, J. S. (2011). A quantum theoretical explanation for probability judgment 'errors'. *Psychological Review* 108, pp. 193–218.

Deerwester, S., Dumais, S. T., Furnas, G. W., Landauer, T. K. and Harshman, R. (1990). Indexing by Latent Semantic Analysis. *Journal of the American Society for Information Science* 41, pp. 391–407.

Freud, S. (1899). Die Traumdeutung. Berlin: Fischer-Taschenbuch.

Gabora, L. and Aerts, D. (2002). Contextualizing concepts using a mathematical generalization of the quantum formalism. *Journal of Experimental and Theoretical Artificial Intelligence* 14, pp. 327–358.

Griths, T. L. and Steyvers, M. (2002). Prediction and semantic association. In: *Advances in Neural Information Processing Systems*, 15, pp. 11–18. Massachusetts: MIT Press.

Hofmann, T. (1999). Probabilistic Latent Semantic Analysis. *Proceedings of the 22nd annual international ACM SIGIR conference on Research and development in information retrieval*, Berkeley, California, pp. 50-57.

James, W. (1910). *Some Problems of Philosophy*. Cambridge, MA: Harvard University Press.

Kahneman, D. (2003). A perspective on judgment and choice: Mapping bounded rationality. *American Psychologist* 58, pp. 697–720.

Khrennikov, A. Y. and Haven, E. (2009). Quantum mechanics and violations of the Sure-Thing Principle: The use of probability interference and other concepts. *Journal of Mathematical Psychology* 53, pp. 378–388.

Landauer, T. K. and Dumais, S. T. (1997). A solution of Plato's problem: The Latent Semantic Analysis theory of the acquisition, induction, and representation of knowledge. *Psychological Review* 104, pp. 211–240.

Landauer, T. K., Foltz, P. W. and Laham, D. (1998). Introduction to Latent Semantic Analysis. *Discourse Processes* 25, pp. 259–284.

Lund, K. and Burgess, C. (1996). Producing high-dimensional semantic spaces from lexical co-occurrence. *Behavior Research Methods, Instruments and Computers* 28, pp. 203–208.

Paivio, A. (2007). *Mind and Its Evolution: A Dual Coding Theoretical Approach*. Mahwah, NJ: Lawrence Erlbaum Associates.

Piron, C. (1976). *Foundations of Quantum Mechanics*. W. A. Benjamin: Reading.

Piron, C. (1990). *Mécanique quantique bases et applications*. Presses Polytechniques et Universitaires Romandes, Lausanne.

Pothos, E. M. and Busemeyer, J. R. (2009). A quantum probability explanation for violations of 'rational' decision theory. *Proceedings of the Royal Society B: Biological Sciences* 276, pp. 2171–2178.

Salton, G., Wong, A. and Yang, C. S. (1975). A vector space model for automatic indexing. *Communications of the ACM* 18, pp. 613–620.

Sloman, S. A. (1996). The empirical case for two systems of reasoning. *Psychological Bulletin* 119, pp. 3–22.

Sun, R. (2002). *Duality of the Mind*. Mahwah, NJ: Lawrence Erlbaum Associates.

Van Rijsbergen, K. (2004). *The Geometry of Information Retrieval*, Cambridge, UK: Cambridge University Press.

Widdows, D. (2003). Orthogonal negation in vector spaces for modeling word-meanings and document retrieval. In: *Proceedings of the 41st Annual Meeting of the Association for Computational Linguistics*, pp. 136–143.

Widdows, D. and Peters, S. (2003). Word vectors and quantum logic: Experiments with negation and disjunction. In: *Mathematics of Language* 8, Indiana, IN: Bloomington, pp. 141–154.

Widdows, D. (2003). Orthogonal negation in vector spaces for modelling word-meanings and document retrieval. In: *Proceedings of the 41st Annual Meeting of the Association for Computational Linguistics* (pp. 136–143). Sapporo, Japan, July 7–12.

Widdows, D. (2006). *Geometry and Meaning*. CSLI Publications: University of Chicago Press.

Widdows, D. (2008). Semantic vector products: Some initial investigations. *Proceedings of the Second AAAI Symposium on Quantum Interaction. London*: College Publications.

Widdows, D. (2009). Semantic vector combinations and the synoptic gospels. Lecture Notes In: *Artificial Intelligence* 5494, pp. 251–265.

TELOS AND COMPLEXITY[1]

Kigen William Ekeson

ABSTRACT. I will develop a general model of causality based on conditionality. From there I will develop a topological hierarchy whereby distinct categories of natural phenomena are modeled according to their relative complexity. I contend that it is only in doing so that the nature and function of telos can be convincingly identified and defined relative to other phenomena that exhibit no teleological behavior. I will then show how both quantitative and qualitative modes of describing conditioned states arise as expressions of teleological agency. I will conclude by summarizing some of the broad implications of what the entire model suggests regarding telos and the human condition.

[1] First submitted to the FQXi FORUM: Wandering Towards a Goal Essay Contest (2016-2017); https://fqxi.org/community/forum/topic/2790.

INTRODUCTION

Ours is a universe of complexity, and telos is its highest expression. In order to show how this is indeed the case, a broad model of causality based on the ideas of the 3rd century CE Indian philosopher, *Nāgārjuna* will be presented. Then, a way to topologically differentiate this broad model into discrete orders of complexity will be developed such that the emergence of telos (i.e., purpose) can be clearly identified and defined.

To do this, it will be necessary to clarify the difference between intrinsic and extrinsic properties of complexity. By intrinsic properties, I mean the inherent conditions that give rise to some entity, while extrinsic refer to properties projected upon one entity by another. Take for example a fork; mass, shape, and molecular composition are all intrinsic properties that comprise fork. Many of these properties can be quantified with great precision. However, one cannot quantify the purpose that a fork has towards food, or to the humans who use it, as such properties don't depend only upon intrinsic physical properties, but are extrinsically created and projected upon forks by what I will refer to as some type of subjective agency.

I contend that although every element of space and time expresses itself as an intrinsic subjective condition (i.e., an entity), extrinsic properties can only be created by and are only useful for subjective agencies. I further contend that subjective agency is indeed the equivalent of teleological agency and that any such agency is only expressible through and as some autopoietic entities. Therefore, by describing how autopoietic entities come into being as a specific order of complexity, I will also be describing how teleological agencies comes into being.

My conclusion will show how the deeper implications of the relationship between teleological agency and non-teleological entities suggest a new way to understand the true nature and scope of telos and our place in the cosmos.

BACKGROUND

Circa 250 CE, the Indian Mahayana Buddhist philosopher *Nāgārjuna* introduced the doctrine of Dependent Co-origination

(*Pratītyasamutpāda*) [1]. Through this doctrine he asserted that all phenomena are completely conditional and therefore empty (*Śūnyatā*) [2] of any unconditioned reality, character, or characteristics (*svabhāva*) [3]. This position stands in general contrast to Western-style empirical approaches, where either material or abstract building-block-type entity(s), forces, fields, or properties are often considered as fundamental [3].

Thus, according to Dependent Co-origination, no objectifiable conditions nor non-material subjective qualities (e.g., panpsychic or implicate conditions) can describe the universe in its fullest sense, as any such constituents must always themselves be conditional. Therefore, I contend, it is only the dynamic and eternal interaction between (conditional) conditions that continuously gives rise to all expressions of reality.

I propose three postulates that I posit are common to any conditioned state:

Postulate 1. Unity; there is an aspect to every conditioned system that corresponds to some single, commonly held boundary for that system, and can be either intrinsic or extrinsically created.

Postulate 2. Polarity; there is an aspect to every conditioned state that corresponds to some relative diversity within the common boundary of a system, describable in terms of conditional opposites, whose interaction over time defines that system.

Postulate 3. Change; there is an aspect to every conditioned state that corresponds to the change brought about through the simultaneous and continuous interaction between the conditional opposites that constitute any system.

A General Model of Causality

In order to illustrate a simple example that models these three postulates, let two polarized circles, one black and one white, continuously merge and then again separate from each other. Thus, in Figure 1, Postulate 1 is modeled by the overall relationship that includes both black and white.

Postulate 2 is modeled by the division of that overall relationship into the conditional opposites of black and white.

Postulate 3 is modeled by the function of the two conditional opposites switching places with respect to each other.

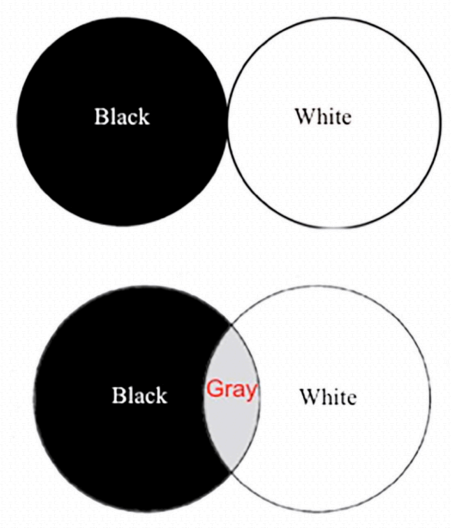


Figure 1. The Intrinsic Entity-Context

In their initial state, black is completely polarized from white. In this state, no internal subjective entity can be modeled because there is no way to intrinsically draw contrast between black and white. However, when black and white begin to overlap via their functional interaction, a new and completely conditional entity of grey is created. It is this area of overlap that I contend models any subjective condition.

Note that once grey is formed, the remaining portions of the two original circles make up a contextual, bifurcated object-field relative exclusively to that newly formed subjective condition. For this reason, I will refer to the entire conditioned state after the subject has been formed, as the entity-context. For example, when a male and a female of some species mate, it is not until their offspring is born that they become 'mother' and 'father'. Here, the pre-subjective context, i.e., male-female, is transformed through the birth of their offspring into the new and unique conditions, relative to the child, we call mother and father.

The entity-context includes both the child and the parents.

Therefore, if the above grey area could think and talk, it would be able to recognize its own intrinsic relationship to both opposites of black and white because it has the unique condition of sharing in the content of both. This quality cannot be modeled by either black or white in their initial polarized state. The area of gray overlap can also be abstractly understood as information [4] because it models the creation of intrinsic data within a given set of parameters in a way that is not coupled to an outside observer.

In order to illustrate the above ideas in a more formal and complete way, let us begin with a single circle (see Figure 2). Let this circle represent any single boundary imaginable (Postulate 1). Let us set the pair of conditional opposites that defined the circle as being the circumference and the exact center (Postulate 2). In order to model continuous and simultaneous change (Postulate 3), let the circumference and center continuously switch places.

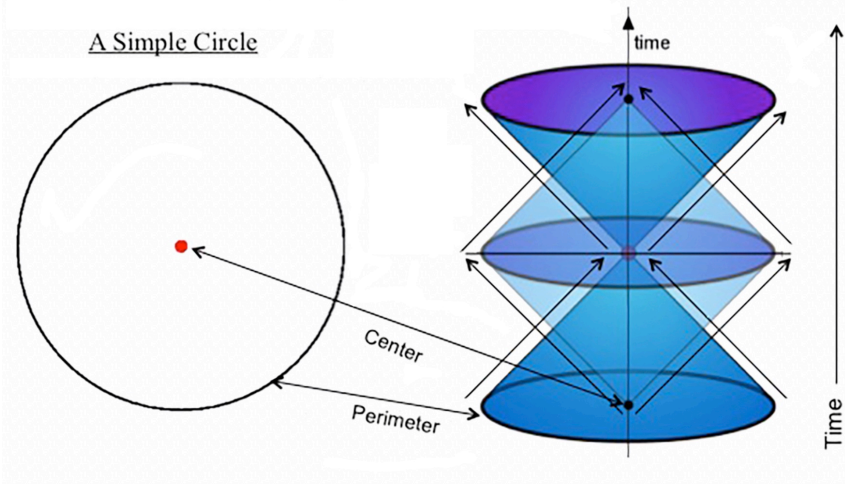


Figure 2. Conditional Opposites Change over Time [color online]

In Figure 3, the two opposing functions of circumference and center are indicated at Polarity I. These two functions change

with respect to each other (Prehistoric) and eventually meet at Unification I. This initial point of unification models a state of relative non-differentiation (i.e., unity) between the conditional opposites, relative to their initial polarized state. After unifying, the conditional opposites switch functions with respect to each other. That is, what was functioning as center, now functions as the relative circumference and vice-versa. In so doing, an area of overlap between the switched functions is formed and expands (Figure 3, Historical Event; Formation).

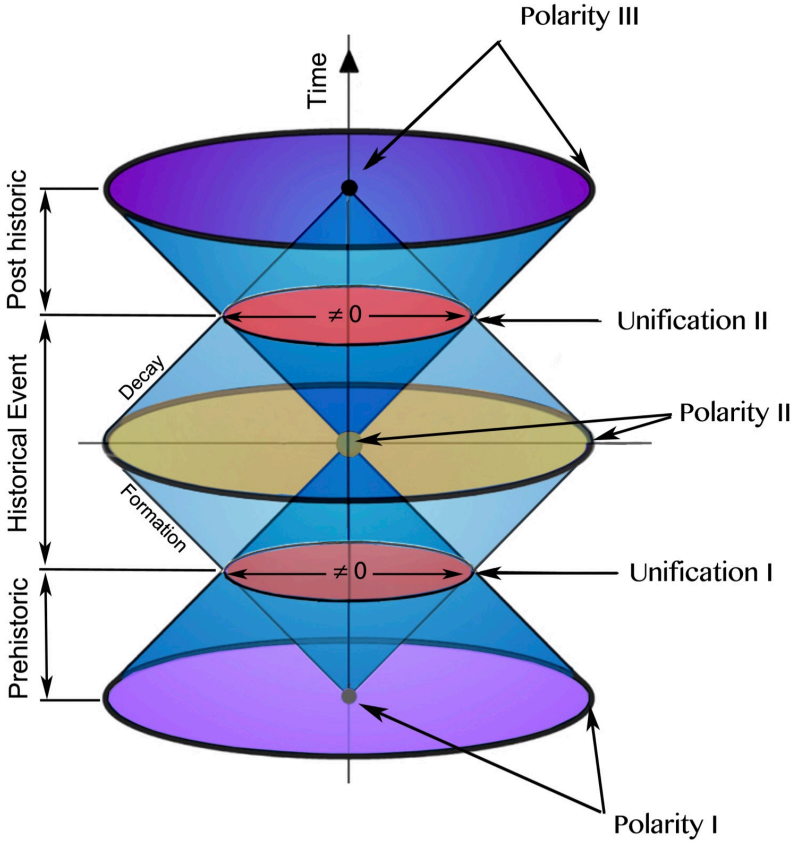


Figure 3. The Cycle of Change [color online]

This area of overlap expresses the same relativistic condition between the opposing functions modeled by the grey area in Figure 1, but is now depicted as dynamically bounded by the contracting circumference (turned relative center) and the expanding center (turned relative circumference). Thus, the growing area of overlap between the progressing functions models the creation of any intrinsic subjective entity surrounded by its opposing contextual limits.

This can alternatively be understood as any historical event, or (as stated above) as the creation of information. This new condition will grow until the opposing functions reach the origins of their conjugal opposite (i.e., Polarity II). Then, as continuous change is required, the opposing functions of center and circumference must begin to move back towards their original orientations. When this begins, the entity-context will simultaneously begin to decay.

At the area where the returning functions meet at their second point of unification (Unification II) and cross back into their original functions, the annihilation of the entity/context is complete (although a new one will immediately be formed). Just as in Figure 1, every entity/context relationship (i.e., Historical Event) is necessarily 'bookended' by pre-event and post-event conditions relative to itself. Thus, 'Pre-historic' and 'Post-historic' conditions are pre-informational and post-informational states relative only to some specific Historical Event i.e., unit of information.

COMPLEXITY

What I have shown is that a general model for the conditioned nature of all entity-contexts can be described using *Nāgārjuna*'s ideas about Dependent Co-origination and a few simple diagrams. What I would like to do now is to present a model made up of four (ultimately, five) orders of complexity that correspond to different types of physical entities, in order to show how their differences might be understood in terms of relative complexity rather than from any purely objective states or qualities.

However, I am not a scientist, and the following is meant to be

a philosophical thought experiment using broad swaths of different phenomena as a way to explore a link between entities exhibiting teleological agency and all other entities. The list below in no way implies that it is exhaustive of all possible orders of complexity, but hopefully these four can serve as an interesting beginning. The four orders of complexity will be:

(1) *Massless entity-contexts in super-position.*
(2) *Massive entity-contexts in super-position.*
(3) *Non-autopoietic macro-level entity-contexts.*
(4) *Autopoietic macro-level entity-contexts.*

In Figure 4, we see the same oscillation between polarity and unification as in Figure 3, expressed as simple black, white, and gray circles, and described as a 720º cycle. Of course, this diagram only shows a single cycle. In reality the cycle repeats: continuously creating new completely conditional expressions over time. Therefore, if we take the abstracted black and white diagram cycle of change in Figure 4 and join its pre- and post-event polar states, we get a continuous 720º loop (See Figure 5).

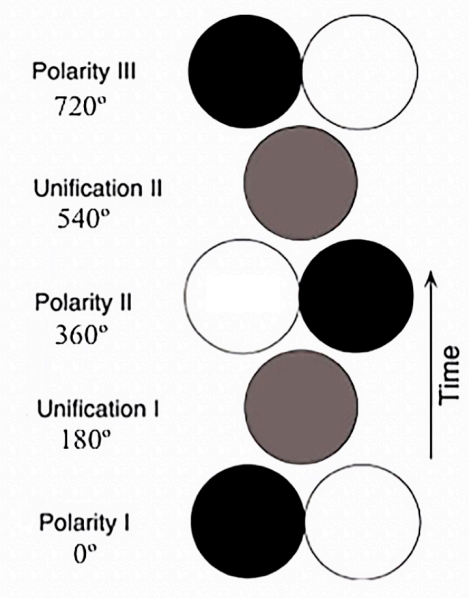


Figure 4. Abstract Cycle of Change

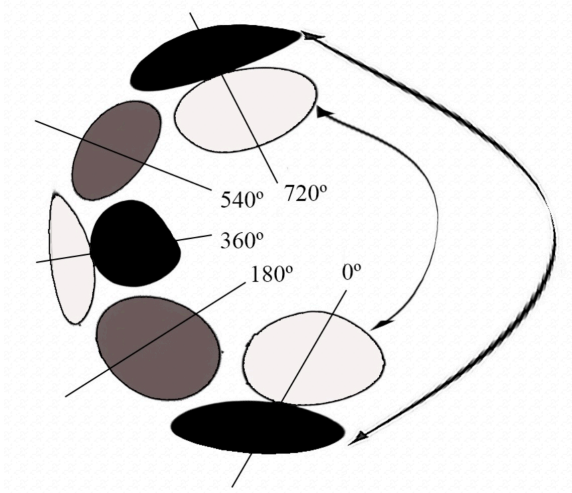


Figure 5. Abstract Cycle Loop

This 720º loop is expressible using a shaded Möbius strip (Figure 6). The Möbius strip is a two-dimensional topological manifold with only a single edge and one side [5].

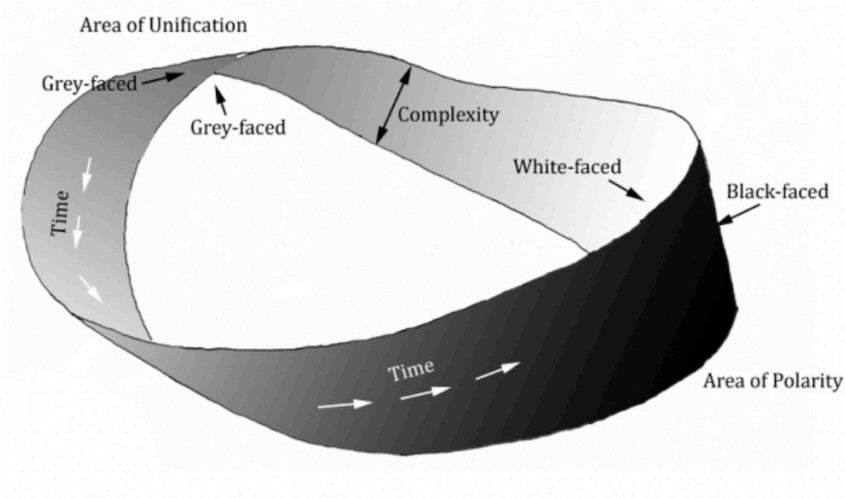


Figure 6. The First-order Complexity

However, in cross-section, its one side can be divided into two conjugal faces at every point along it. Let these conjugal faces represent the conditional opposites that define any overall conditioned state. To exactly mirror the abstract diagram for change (Figure 4), at some point along the strip, let one face be completely black and the other white. At the point 180° from this black/white area, let both faces be uniformly gray. Let the area between the black/white faces and uniform gray gradually transition to each other. Because it takes a 720º progression (i.e., two times around) along the face of any Möbius strip to return to the starting point, if we begin on the point of greatest polarity on the black face, it will take a 720º progression to return to that same black/white orientation, but in so doing, the orientations of black, white, and gray will have cycled through the unification and polarized "switching", relative to their conjugal face, in perfect keeping with the abstract cycle for change diagram (Figure 4).

In all the topological examples to follow, let the longitudinal dimension represent the temporal change for whatever system of opposites is being modeled, while the latitudinal dimension will represent the relative degree of complexity within the entire four-order system. In the Cycle of Change diagram (Figure 3), the entity-context (Historical event) is produced as a new spatially distinct condition created by the switching circumference and center. However, in the case of the first-order of complexity (Figure 6) there is no new spatially (or temporally) distinct area created between the conditional opposites of black and white. That is, relative "space-time" does not manifest at this simplest of levels. Rather, the "switching" expressed by this most fundamental of systems (i.e., as some massless micro-level particle in relationship to everything that is not that particle) only express a kind of temporal re-orientation with no secondary/spatial dimension whatsoever.

One might say that these simplest expressions manifest as time rather than within it. Thus, the first-order of complexity can be as simple (and awesome) as a single photon in direct relationship with the rest of the universe. It is this type of one-to-one relationship that offers a simple explanation for quantum entanglement [6, pp. 290–294]. That is, even when the first (or

second)-order particle is itself divided into conjugal sub-particles (by various means), there can be no intrinsic "distance" separating them because spatial complexity is meaningless for such systems. Therefore, both entangled parts of a split photon are still intrinsically unifying and polarizing as a single photon from the rest of the universe. It is only we, as complex higher-order systems, who observe a non-local [6, p. 294] correlation between the two (what we perceive as) spatially separated sub-particles and extrinsically label as "spooky action-at-a-distance" [7].

The difference in complexity between our higher-order conditioned state and the first-order also suggests a simple explanation for why the speed of light is the universal speed limit, and is always measured as constant, regardless of the speed of its source [8]. That is, since first-order complexities are the simplest expression of conjugal opposites, the speed of light could simply be understood as the fastest rate at which any Cycle of Change can occur. Furthermore, it also stands to reason that no matter how fast any particular macro-level entity embedded within the universe is traveling, the speed of the "light" i.e., the electromagnetic wave, originating from it will always be the same (when measured by any macro-level observer) because every photon is, by this hypothesis, definitively engaged with the universe as a whole.

Therefore, it is as though any pair of macro-level eyes are the universe's eyes, and so every pair sees photons polarizing from itself (over time) at the same rate, regardless of how fast different sets of "macro-level" eyes (different reference frames) are moving relative to each other. One could paraphrase *John Donne*'s famous lines from "Devotions Upon Emergent Occasions" [9] to read: Ask not from what the beam of light is bursting forth from (nor be concerned with the speed of its point of origin) for it bursts forth from Thee!

How then to model massive entities in superposition? In the second-order of complexity (Figure 7), we add another level of contrast between the grey and black/white faces by letting the width become wider where black/white is polarized (i.e., greater contrast), and narrower at the gray area (i.e., less contrast; see Figure 7). In order to do this, it also necessitates the inclusion of

a lateral curve along the entire longitudinal dimension. This lateral curve begins the evolution of the Möbius strip topology towards that of a Klein bottle [10] (i.e., the third-order of complexity), and models some profound differences relative to the first-order. The open edges of the Möbius strip in the first and second-orders represents the lower limit of complexity: as freely moving entity-contexts in global superposition with the entirety of the universe i.e., a wave-function [6, pp. 290–294].

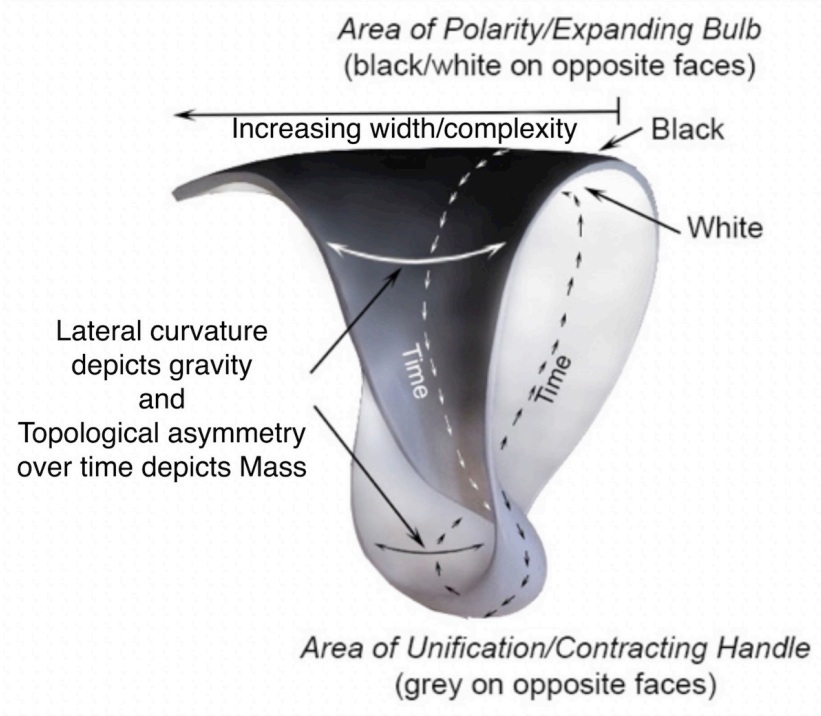


Figure 7. The Second-order Complexity

However, the addition of the second-order's lateral curve quite literally introduces a physical bend into the previously flat, first-order fabric of time. Thus, I hypothesize that the lateral curve present in all the proceeding levels of complexity represents gravity (i.e., the curving of space-time), while the resulting topological asymmetries created over the 720º Cycle of Change (in contrast to the topologically symmetric first-order) model the

Pauli Exclusion Principle [11] and thus, indicate mass [12]. Therefore, in this general mapping of complexity, first-order complexities could correspond to massless bosons and second-order to freely moving fermions [13].

Like the Möbius strip, a Klein bottle is also a two-dimensional manifold embedded in three-dimensional space, but unlike the Möbius strip, the Klein bottle has no edge: it is a closed surface [13]. The third-order of complexity (Fig. 8) can be modeled as a modified Klein bottle (MKB), and depicts a cycling entity-context that topologically has no edge. This means that the system represented does not exist at the lower limit of complexity, i.e. not able to manifest as a super-position between some entity and the entire universe. Rather, third-order expressions give rise to localized, structurally distinct entity-contexts embedded within some larger limited context. Therefore, the exact point of transformation from freely moving lower-order super-positions (first- /second-orders) into a third- (or fourth) order complexity can be understood as the collapse of the wave-function [6, pp. 290–294].

Diagrammatically, there are differences between a normal Klein bottle and the MKB shown in Figure 8. One of the most important being that at the point where both faces are uniformly gray, the handle of the bottle collapses to the smallest point of unification possible for the system (corresponding to Figure 3, Unification I). Then, in keeping with the Cycle of Change, inner and outer faces actually pass through and invert their functions with respect to each other. Diagrammatically, this creates a new dimension of contrast (i.e., greater distinction between unity and polarity) modeled by an inner and outer switching of sides.

This switch creates a progressing “wave” along the length of the MKB representing the macro-level creation, growth, and decay of any inanimate localized and historical event. By contrast, in the first two orders of complexity (see Figures 6 and 7), have no such temporally limited and spatially structured macro-level progression created between the cycling opposites. The lack of such structure in the first two orders makes quantum superposition and entanglement possible for them, and largely impossible for third-order entities (with qualified exceptions). That is, because every third-order system is characterized by

being embedded within the universe as a whole rather than manifesting as the totality of it, they necessarily have a local space-time past, present, and future that changes according to local interactions. This is just another way of saying that third-order complexities can evolve deterministically.

Thus, once the elements making up third-order conditional opposites have been quantified, then the structure of future entity-contexts for the system can be predicted, often with great accuracy. This is modeled by the third-order MKB having only a single handle through which its entity/context is formed, grows, decays, disappears, and is re-formed. However, although third-order complexities are macro-level localized relationships that involve deterministic processes, they exhibit no autopoietic characteristics.

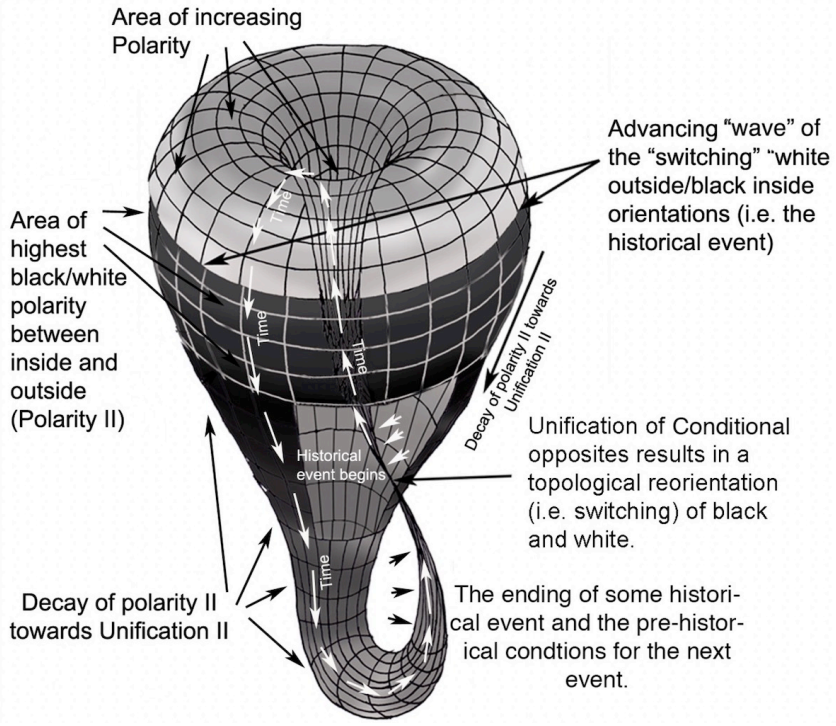


Figure 8. The Third-order Complexity

The fourth-order of complexity (Figure 9) is distinguished from the third-order in that it manifests a completely new level of ontological organization beyond that of merely for accounting for either quantum-level or deterministic expressions. Specifically, the fourth-order gives rise to an intrinsic, non-material condition that expresses subjective agency (autopoiesis).

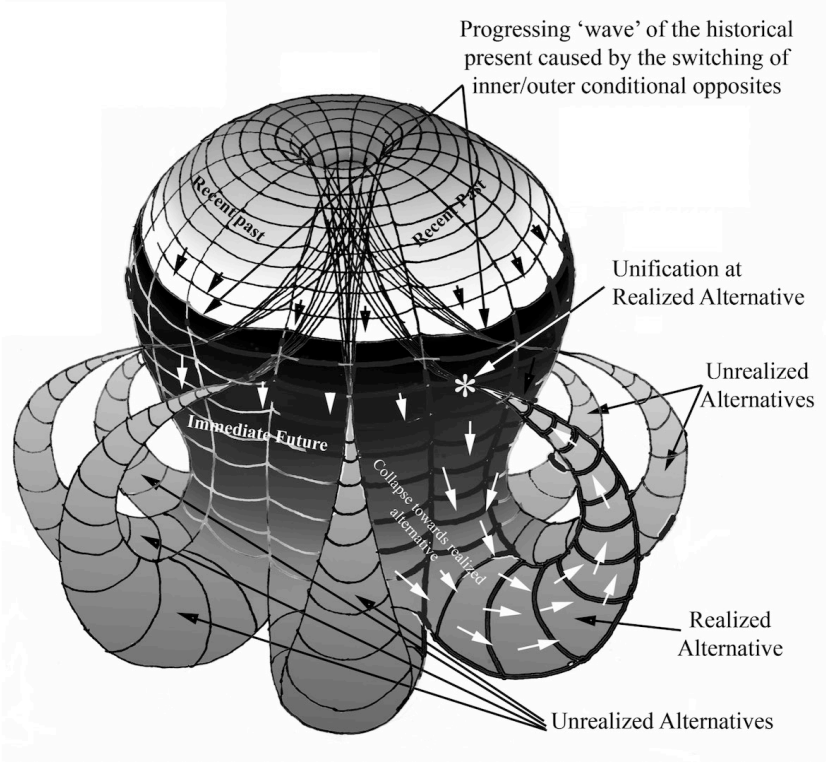


Figure 9. The Fourth-order Complexity

Going back once more to Figure 1, this subjective agency might be crudely modeled by the actual line that differentiates the grey area of overlap from its black-and-white context. Indeed, the simplest fourth-order entities require little more than specialized membranes [14] surrounding primordial "goo" in order to function. These membranes have the capacity to regulate the manner in which their inner and outer conditions reconnect over time (at Unification II, Figure 3). However, it is a fundamental

error to mistake the membrane itself for the fourth-order agency. Rather, it is the actual, non-material capacity for regulation itself that is the fourth-order subjective agency, not the material constituents that allow for such agency. That is, to regulate is to control, and at the simplest biological levels, control transforms a system of single-outcome deterministic conditions into some innovative expression of control that ultimately promotes the survival of that control through the generation of more or better adaptive alternatives.

Once this level of intrinsic complexity comes into being, evolution begins, giving rise to more and better ways to connect inner and outer conditions. These alternatives are modeled in Figure 9, via the addition of extra handles to the modified Klein bottle. Each alternative depicts a different type of inner and outer connection possible for some system with the result being some degree of subjective agency. Each successful connection resulting the continuation of control, in turn gives rise to some new subjective agency, depicted as a newly switched progressing wave (see top of Figure 9).

From this approach it is not hard to see how primitive fourth-order entity-contexts evolve into those with more and more sophisticated, interactive alternatives yielding greater and greater success at survival. Thus, control evolves to behavior, and behavior to experience (i.e., qualia [15]). I suggest that it is with-and-as the arising of intrinsic subjective agency, that teleological agency, in all its forms, comes into being.

Of course, one might argue that this is not true purpose; that it is just the various processes of the universe mimicking purpose. But if, as I contend, that the progressive differentiation of all known entities is fundamentally based upon an increase in complexity, then I would argue that the function of the universe is indistinguishable from purposeful behavior in the broadest sense because there are no entities of equal or greater physical complexity than those expressing subjective agency. Thus, the universe appears to have a definitive and hierarchical goal.

Specifically, that goal is: to bring about greater complexity whenever circumstances allow. And, since subjective agency appears to be the penultimate expression of complexity, one can rationalize two alternatives. The first is that the universe is

simply blind causation that happens to give rise to teleological agency (i.e., the purpose of survival) or one can suggest that the entire universe is purposefully working toward the creation of teleological agency. As to the question of whether or not there is conscious intentionality behind said hierarchical goal, it is not something that we, as limited denizens of this universe can conclusively either affirm or refute, as any such answer is, as it were: "above our pay grade".

As mentioned above, every fourth-order agency-context gives rise to its own expression of ontological control, yet it is completely dependent upon extrinsically transforming and incorporating lower or like-orders of complexities into its own intrinsic fourth-order alternatives. Therefore, just as a photon (first-order) hitting a stone (third-order) is physically transformed into the stone's third-order entity-context (via its molecular structure), the fourth-order human can also physically "collapse" a photon's first-order state into its own fourth-order condition by the mere act of experiencing it (via some physical observation/measurement) as alternatively existing either "here" or "there".

Even though the Quantum Measurement Problem [6, p. 312] is not the topic of this essay, it is this same principle that I contend, explains how and why all measurements and observations extrinsically transform lower or like-order complexities into higher, fourth-order alternatives i.e., qualia. Essentially, through observation (or any thoughts, actions, or sensations) we have the capacity to collapse first, second, third, and other fourth-order conditions into our own intrinsic fourth-order content. Thus, even our quantitative knowledge about a fork, no matter how precise, is still not an actual third-order fork but rather, is an extrinsic fourth-order transformation of some intrinsic localized third-order conditions that give rise to a bit of steel that we call a fork. However, because fourth-order experiences are not limited only to quantitative analyses, we are also able to transform the fork into other astoundingly complex qualitative abstractions that are created as we learn to use forks in a multitude of ways.

If all forms of quantitative and qualitative analyses are fundamentally fourth-order creations used by us in order to transform lower- or like-order systems into our own, intrinsic

fourth-order content, then in so doing we literally create a truly new dimension of reality: a world of fourth-order imagination. That is, mathematical formulas, observed photons, as well as poetry, or any ideas about the best way to use a fork, all spring from and return to the exact same source: our own intrinsic fourth-order ability to extrinsically transform lower or like-order into new ways to purposefully connect (i.e., regulate) our own inner and outer conditions.

However, quantitative analyses are typically far more useful for describing lower-order or deterministic fourth-order experiences than say, poetry, because deterministic and quantum-level systems all tend, due to their intrinsic complexity, towards single, highly predictable pathways (see Figures 6, 7 and 8); pathways that can be precisely calculated using mathematics or other forms of quantitative summation. But, even if our mathematics progressed far beyond our current capabilities and allowed us to predict complex qualitative fourth-order experiences, they would still be just further stunning, fourth-order expressions of the human condition, extrinsically transforming more and more of our inner and outer environs into our own ever-expanding and purposeful content.

However, there is something much more profound than simply our intrinsic ability to transform and describe elements of both lower and like-orders. That 'something' is (as I have outlined) that all orders of complexity share in a single common cycle of change, i.e., an ultimate algorithm, that lies at the heart of everything from a photon, to a sad love song, to the universe itself.

This leads me to one last order of complexity in this already perhaps too-elaborate thought-experiment. That is, suppose the entirety of the universe is also engaged in its own continuous Cycle of Change as a fifth-order of complexity. Then, just as in the third and fourth-orders, perhaps there is a "moving wave" of the currently expanding universe, where space-time is continuously "ripped" into existence by its own crisscrossing and expanding set of conditional opposites. Perhaps each great, universal cycle alternatively gives rise to matter- and then anti-matter expressions of itself. Of course, this would mean that all lower-orders of complexity would necessarily be part of this

great, shared and universal cycle. This would perfectly explain the Arrow of Time i.e., entropy, as the general and inexorable universal flow of time in one direction experienced by all.

CONCLUSION

If, as I have just suggested, the universe as a whole, and all of its known parts, can be understood as various interacting and ascending (whenever circumstances allow) layers of complexity, then the vast expanses of space and time, energy, size, and speed, all of the things we feel dwarfed by in-and-as this vast universe, are in fact dwarfed by us, in terms of intrinsic complexity.

That is, since the fourth-order of complexity is the most concentrated expression of complexity we have yet encountered, and is the sole vehicle through which a wondrous and uniquely supervening dimension of human reality comes about, could not the whole universe be understood as evolving towards purposeful agency? Evolving towards us? Does this not make the human condition indeed the pinnacle of Creation?

REFERENCES

[1] Garfield, J.L. (1994). Dependent Arising and the Emptiness of Emptiness: Why Did Nāgārjuna Start with Causation? *Philosophy East and West* 44, pp. 219–250.

[2] Ornatowski, G.K. (1997). Transformations of 'emptiness': On the Idea of Sunyata and the Thought of Abe and the Kyoto... *Journal of ecumenical studies* 34(1), pp. 92–115.

[3] Maxwell, Nicholas (2008) Do We Need a Scientific Revolution? *The Journal of Biological Physics and Chemistry*, vol. 8, no. 3, Sec. III.

[4] Floridi, L. (2010). *Information: A very short introduction* (p. 22), OUP Oxford.

[5] Zeeman, E. C. (1966). *An Introduction to Topology. The Classification theorem for Surfaces*. Mathematics Institute, University of Warwick.

[6] Penrose, R. (1994). *Shadows of the Mind*, Oxford: Oxford University Press.

[7] Bohm, D. and Hiley, B. (1977). On the intuitive understanding of non-locality as implied by quantum theory. In: *Quantum Mechanics, A Half Century Later* (pp. 207–225). Springer Netherlands.

[8] Uzan, J.P. and Leclercq, B. (2010). *The Natural Laws of the Universe: Understanding Fundamental Constants* (pp. 43–44). Springer Science & Business Media.

[9] Donne, J. (1624). *Devotions upon emergent occasions*. Meditation xvii.

[10] Franzoni, G. (2012). The Klein bottle: Variations on a theme. *Notices of the AMS*, 59(8), pp. 1094-1099.

[11] Pauli, W. (1994). *Writings on Physics and Philosophy* (pp. 165–181), Springer.

[12] Ekeson, W. (2015). The Zen Interpretation: A General Hypothesis Concerning Quantum States, Individuation, and the Measurement Problem (pp. 19–25). www.academia.edu.

[13] Greiner, M., Regal, C.A. and Jin, D.S. (2005). Fermionic condensates. In: L.G. Marcassa, K. Helmerson and V.S. Bagnato (eds.), AIP Conference Proceedings (Vol. 770, No. 1, pp. 209–217). AIP.

[14] Mansy, S. S. (2010). Membrane transport in primitive cells. *Cold Spring Harbor perspectives in biology* 2, a002188.

[15] Jackson, F. (1982). Epiphenomenal qualia. *The Philosophical Quarterly* 32, pp.127–136.

ABOUT AUTORICERCA

AutoRicerca is the journal of the *LAB – Laboratorio di Autoricerca di Base* (Laboratory of Basic Self-Research). Its mission is to publish writings of value, usually in Italian (some volumes are also available in English) on the broad theme of *research*, inner and outer.

Standing outside the usual editorial categories, *AutoRicerca* offers to its readers articles of a high level, selected, translated and checked personally by the editor. These works, although they usually require some effort to be assimilated – some should be studied more than read – remain nonetheless accessible to the willing general reader who is really eager to learn something new.

In accordance with the *Berlin Declaration*, which states that the dissemination of knowledge is only half complete if the information is not made widely and readily available to society, *AutoRicerca* is an *open access* journal.

More specifically, this means that the volumes in electronic format (pdf) are freely downloadable from the site of the *LAB*.

The open access to the electronic version does not preclude the possibility to order the paper volumes (one can also order a single volume), the purchase of which is a way to support the mission of the journal.

If you wish to be informed about the new releases (the actual cadence is of two issues a year), you can subscribe to the mailing list, by sending an email to the following address: *autoricerca@gmail.ch*, indicating in the object "mailing-list-journal," and specifying in the body of the message the name and country of residence.

PREVIOUS VOLUMES

NUMERO 1, ANNO 2011 – LO STATO VIBRAZIONALE

Un approccio alla ricerca sullo stato vibrazionale attraverso lo studio dell'attività cerebrale (*Wagner Alegretti*)

Attributi misurabili della tecnica dello stato vibrazionale (*Nanci Trivellato*)

Dal pranayama dello Yoga all'OLVE della Coscienziologia: proposta per una tecnica integrativa
(*Massimiliano Sassoli de Bianchi*)

NUMERO 2, ANNO 2011 – FISICA E REALTÀ

Proprietà effimere e l'illusione delle particelle microscopiche (*Massimiliano Sassoli de Bianchi*)

Un tentativo di immaginare parti della realtà del micromondo (*Diederik Aerts*)

NUMERO 3, ANNO 2012 – L'ARTE DI OSSERVARE

L'arte dell'osservazione nella ricerca interiore
(*Massimiliano Sassoli de Bianchi*)

NUMERO 4, ANNO 2012 – SCIENZA E SPIRITUALITÀ

Yoga, fisica e coscienza (*Ravi Ravindra*)

Cercare, ricercare, autoricercare…
Speculazioni su origine e struttura del reale
(*Massimiliano Sassoli de Bianchi*)

NUMERO 5, ANNO 2013 – OBE

Scoprire la tua missione di vita (*Kevin de La Tour*)

Esperienze fuori del corpo: una prospettiva di ricerca (*Nanci Trivellato*)

Filtri parapercettivi, esperienze fuori del corpo e parafenomeni associati (*Nelson Abreu*)

Elementi teorico-pratici di esplorazione extracorporea (*Massimiliano Sassoli de Bianchi*)

NUMERO 6, ANNO 2013 – ENERGIA

Una sottile rete di luce (*Andrea Di Terlizzi*)

Bioenergia (*Sandie Gustus*)

Energie sottili o materie sottili? Una chiarificazione concettuale

Trasferimento interdimensionale di energia: un modello semplice di massa (*Massimiliano Sassoli de Bianchi*)

NUMERO 7, ANNO 2014 – SCIENZA, REALTÀ & COSCIENZA

Scienza, realtà e coscienza. Un dialogo socratico (*Massimiliano Sassoli de Bianchi*)

NUMERO 8, ANNO 2014 – ARCHETIPI

Astrologia elementale e aritmosofia (*Vittorio Demetrio Mascherpa*)

La nuova astrologia (*Nadav Hadar Crivelli*)

Corrispondenze astrologiche: una prospettiva multiesistenziale (*Massimiliano Sassoli de Bianchi*)

NUMERO 9, ANNO 2015 – CORRISPONDENZE

Dialogando con Misha e Maksim (*autori anonimi*)

NUMERO 10, ANNO 2015 – STUDI SULLA COSCIENZA

Risultati preliminari sul rilevamento di bioenergia e dello stato vibrazionale mediante fMRI (*Wagner Alegretti*)

Requisiti per una teoria matematica della coscienza (*Federico Faggin*)

Studi preliminari su evidenze di pseudoscienza in coscienziologia (*Flávio Amaral*)

Fisica quantistica e coscienza: come prenderle sul serio e quali sono le conseguenze? (*Massimiliano Sassoli de Bianchi*)

NUMERO 11, ANNO 2016 – CORRISPONDENZE BIS

Dialogando con Misha e Maksim… e alcuni altri
(*autori anonimi*)

NUMERO 12, ANNO 2016 – DIALOGO SULLA REALTÀ

Tra mentore e pupillo. Dialogo sulla realtà / Between mentor an pupil. Talking about reality (*Massimiliano Sassoli de Bianchi*)
[ALSO AVAILABLE IN ENGLISH] ⇦

NUMERO 13, ANNO 2017 – DIALOGO SULLA MALATTIA

Tra mentore e pupillo. Dialogo sulla malattia
(*Massimiliano Sassoli de Bianchi*)

NUMERO 14, ANNO 2017 – NDE

NDE – La prova della sopravvivenza (*Andrea Pasotti*)

NUMERO 15, ANNO 2018 – NDE

Lo Yoga Darshana di Patanjali
Elementi di Sadhana dello Yoga
(*Massimiliano Sassoli de Bianchi*)

NUMERO 16, ANNO 2018 – DUE CUORI

Due cuori / Two hearts (*Massimiliano Sassoli de Bianchi*)
[ALSO AVAILABLE IN ENGLISH] ⇦

NUMERO 17, ANNO 2019 – SPUNTI DI OSSERVAZIONE

Spunti di Osservazione (*Antonella Spotti*)