BREAKING WALLS TO BUILD BRIDGES:

DEMOCRACY AND THE STRUGGLE BETWEEN BELIEF AND REASON

by

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ABSTRACT OF THE DISSERTATION

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Public support for social policies or movements is often determined by intuitive considerations, perceived as matters of common sense. Existing theories interpret these dispositions in one of two ways: either as genetic traits inherited from hominid ancestors (evolutionary psychology), or as reified elements of cultural practices (social constructivism). Both of these approaches imply that common sense is local and context-dependent, without any primordial components. Nevertheless, rationality cannot emerge in material environments without a set of necessary beliefs. This means that common sense incorporates universal elements as well. By treating shared factual knowledge as subjective and the basic intuitions as objective (not the other way around), it is possible to understand the roots of cultural paradigms and the parameters that lead to their change over time. The interplay between belief and knowledge determines the type of principles that have the strongest appeal in any society. This process works at the level of the individual, especially in the early formative years, and shapes the generational transfer of values. Of special interest is the possibility of cultural change induced by advancements

in science. For example, the social relevance of scientific rationality depends on the perceived compatibility between the necessary intuitions and the supported interpretations of physical phenomena. Global effects are possible in the long run, given the universality of relevant categories. Even the modern trend towards cultural fundamentalism can be reversed, assuming favorable conditions. The goal of this dissertation is to provide a foundation for future research on the evolution of common sense. It is designed as an argument in three main steps. The first part aims to deduce the types of internal and external observables that determine the emergence of rational self-consciousness. The second part derives a limited list of physical properties that can be used to validate the ontological status of rationality. Those properties are shown to be compatible with existing empirical observations (but not with their interpretation) in the third part. These conclusions suggest that the progress of democracy *can* be influenced by future scientific developments, especially through changes in the qualitative approaches to fundamental physical interactions.

ACKNOWLEDGEMENTS

This dissertation is a dream come true, but it is not a miracle. It took an extraordinary amount of time and resources to complete, and I could only afford to stick to it because of the sacrifices of my loved ones. Most of the expenses related to my education, research and travel to scientific events in the past ten years were covered by my wife, Georgeta Mardari. She never stopped encouraging me, when others might have despaired. Some friends called me crazy for choosing such a daunting project, but the truth is that there were two of us, through thick and thin. If that was not enough, our parents also joined in the fun, going beyond their means to keep things going. My mother, Galina Mardari, deserves special credit for sponsoring my experiments, and for countless other material and moral contributions. My achievements would have been impossible without the symbiotic engagement of my family. Though, nothing is impossible for people who can experience that kind of support and devotion.

I am also grateful to George Soros, for funding the first five years of my graduate career through the Open Society Institute and the Central European University (CEU). It was not his personal decision to help me, but it was his ideals and his money that created wonderful opportunities for me and many of my fellows. Moreover, his attempt to change the world without trying to change the people was a powerful example that influenced my work. Shortly after joining the CEU, I discovered an unsuspected predilection for

theoretical endeavors. János Kis, Stefano Guzzini, and the late László Csontos acted as the custodians of my mental arsenal, with much wisdom and patience. They gave me knowledge, but above all they gave me the intellectual tools to grow for years.

It was also at the CEU that I met Dennis Bathory and Jan Kubik for the first time. They convinced me that Rutgers was the right place for me, and I see now that they were right. (Though, I wonder if they still share the sentiment). It is only fitting to have both of them on my dissertation committee, considering the amount of energy that they spent on me. Whatever mental discipline I have by now, it is due to their efforts. At first, I thought that I would write my thesis in comparative politics, with Jan. However, my heart was beating faster at the pro-seminar on political philosophy. By the time we finished discussing the *Oresteia*, I had already discovered my dissertation topic. Though, it would take a few more years (and the shock of 09/11/01) before I could properly express the link between cultural evolution and common sense.

My style of research was greatly influenced by Benjamin Barber, particularly through his seminar on Enlightenment. He raised a set of interconnected questions at the beginning of the course, and then allowed us to forget about them, while we focused on various traditions in greater depth. The unexpected effect took place at the final session, when he "put up in the air" all the pieces that we learned, "switched on" the initial framework that was laying dormant in our minds, and then let everything fall in its place. It was an unforgettable experience. After that, my brain was never the same. Remarkably, this dissertation was written in a similar manner. I spent a couple of years trying to find the right way to ask a few questions. Then I followed each strand to its logical conclusion, and ten years later everything fell in the right place.

Thought is like a campfire, at least in my experience: one needs to collect enough firewood in the appropriate place, and then one needs a spark. In my formative years at Rutgers, I went through many brush fires. Yet, when I had the right kind of burning matter, it was either damp, or I was out of matches. Luckily, there was always a class by Stephen Bronner that I could attend. For some reason, it always felt as if he was thinking my thoughts during those lectures, and that he cared about the same things that I cared. More importantly, he was always raising important questions, without giving us his answers. At some point, I started finding my own solutions, which lead to more questions. That is how I became an independent thinker. My dissertation was motivated by many of those initial questions, even though my search for answers took me far away from our common platform.

I crossed the border between a potential project and a real one when I met Ernest Sosa, a visiting professor at the Department of Philosophy at Rutgers. He helped me realize that epistemology was a junkyard with many hidden treasures, which I had to find and put together by myself. During one of Sosa's seminars, it occurred to me that recent advancements in philosophy can be used to reconsider old questions that were left behind. One thing led to another, and soon enough I discovered the power of a Kantian approach to rational self-consciousness. I experienced that as a major breakthrough. Until that moment, it felt as if I was knocking at the wrong doors, asking the wrong questions.

The person who had the greatest impact on the actual content of my dissertation was Barry Loewer. I sought his counsel on some issues related to the philosophy of physics, but we ended up debating the subtleties of free will for several years. (As it turned out, this was the concept that brought together all the different aspects of my

research). I never met a person who could listen like Barry, and maybe that is why his feed-back was the most useful. I hope that I can grow to be like him, in this respect, some day. It is from our intellectual relationship that I finally learned how to think like a philosopher. There is a good chance that I might even become one some day.

This project was too complex for a doctoral project, which is why it took so much time. However, I felt that I had to do it, because of the feelings that it gave me, especially when I was doing the relevant research in physics. My first steps in this domain were guided by Pierce Coleman and Frank Zimmermann, from the Department of Physics at Rutgers, and later on I benefitted from a good nudge from Shelly Goldstein, at the Department of Mathematics. Most of my growth as a physicist was nurtured through the internet by a small army of enthusiastic researchers, who saw it fit to give me generous feed-back and references for independent study, when I needed it the most. Among the most helpful correspondents, I wish to mention Serafino Cerulli-Irelli, Andrei Khrennikov, Gregg Jaeger, Yoon-ho Kim, Giuliano Scarcelli, Yanhua Shih, Jack Sarfatti, Giorgio Kaniadakis, Maurizio Consoli, Sergei Kopeikin, Shahriar Afshar, and Eduardo Flores. Numerous other scientists sent helpful comments about my papers and answered occasional questions by e-mail or in person, at conferences.

I feel that I reached the deepest understanding of theoretical physics by doing experimental investigations. I owe a lot to Chandrasekhar Roychoudhuri for that. He gave me the chance to work at his Photonics Lab in Connecticut, as a part-time assistant, and allowed me to use his facilities for educational experiments. He opened my eyes to a new way of relating to Nature, and shared many of his professional secrets with me. I had a lot of fun during those two semesters, until I acquired the confidence to set up my own lab in

Piscataway. When I designed my first experiments, I was helped tremendously by Ernst Knoesel, at Rowan University in New Jersey, who shared his experience and some of his equipment with me. My work was raised to a much higher level, when I started collaborating with James Greenwood, an independent researcher from Nevada. We did similar experiments with different settings, and from different points of view, followed by extended debates about our results. I am not able to separate my discoveries from his, though it is remarkable that we use completely different interpretive tools. I look forward to many more years of collaboration with Jim.

Finally, I wish to thank my brother, Igor Mardari, for his influence on my development in secondary school. He infected me with excitement for science, and made sure that I remember one thing: there are no miracles. I live by this principle even today. If I reached farther than others in some areas of research, it is because of this firm belief in causality. I hope that I can pass it to my children, so that they can pass it to theirs.

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I. FROM ENLIGHTENMENT TO ENLIGHTENMENT

Abstract: The modern world is a battleground between two types of ideological movements: tribalism and universalism. In the long run, science is likely to be the deciding factor. Yet, the balance is tipped in favor of tribalism, for now, because of the diminished social relevance of science. The roots of this problem can be found in the apparent contradiction between necessary human intuitions (whose refutation imply a denial of humanity) and existing scientific knowledge about the Universe. The goal is to determine if this problem is produced with necessity by the facts of nature, or by corresponding interpretive theories. A promising strategy is to undertake a reverse-engineering of rational self-consciousness, in order to produce an independent standard for the evaluation of relevant phenomena. The main parameters and findings of this project are explained, as detailed in the subsequent chapters of the dissertation. The contradiction is found to be contingent on transient factors, with interesting implications for political science.

Introduction

In a true democracy, the will of the people must rule. On every matter of supreme importance, the people must have their final say, and no further appeal is possible. But what if the people decided to give up democracy? Or, what if they voted to wage war against a peaceful country, without just cause? Or, what if they chose to deny fair treatment to a defenseless minority? This suite of questions is meant to point out that democracy is not just a procedure, but also a set of important principles. Thus, true democracy can only persist in time if people choose to live by it, day after day and generation after generation. But why should we expect them to make this choice, over

and over? Is it because of some powerful internal impulse? Is it because of providential external influences? Or is it because they have a good *reason* to do so?

Modern democracy derives its foundations from the glorified tradition of Western Enlightenment. It promises to maintain the best possible form of social organization in history. It invokes the "self-evident" validity of several ideas, and appeals to our reason for their acceptance. However, it also applies a standard for discrimination against some types of justification for action. Whenever there is a conflict between competing values, universal principles must prevail over the parochial ones, in agreement with what we call *scientific rationality*. In theory, there are different ways to justify reasons for action, and all of them depend on some type of suitable rationality for their meaning and relevance. Yet, only the scientific mode or reasoning can link assumptions to empirical observations with undisputable precision. It is supposed to be the right one, because its impartiality is transparent, but above all because it works. If there are doubts, it has a method for verification, unlike other systems of thought. Thus, people should favor democracy, because it is founded on principles that conform to the scientific rationality. The authority of science underwrites the authority of democratic values.

In actuality, the role of science is implied, rather than stated. Democracy depends on cultural institutions for its continuity, just like other modes of governance. To a great extent, this is unavoidable. Human knowledge is not inborn and values require sustaining rituals. However, it is also the case that science is always a "work in progress". It cannot invoke ultimate truths for its validity. Science works as a living method that has been successful for several centuries. Yet, philosophically speaking, its foundations are still not fully understood. This problem is increasingly important in our times, when formerly

established social synapses are breaking up. With the explosion of novel technologies for communication, new patterns of socialization are emerging. Larger and larger groups of people become engaged in simultaneous dialogue, while fewer and fewer socially established filters and educational tools are available for guidance. The cultural processes are increasingly decentralized, spontaneous, and chaotic, as various flows of information compete for attention in the minds of isolated individuals. As this trend continues, allegiance to democracy is likely to be less and less a matter of inherited collective identity, and more and more a matter of private choice.

In this new context, democracy cannot prevail just by winning debates, or by providing sophisticated arguments in its favor. Its foundational values have to be self-affirming in the minds of individuals, simply by having the stronger appeal. Can we expect scientific rationality to thrive in this environment (that it created)? It is undeniable that science works, more so than ever before, but does it have the requisite appeal for social relevance? With regard to neutral issues, this is probably the case, considering the omnipresence of scientific outputs. However, allegiances are usually sealed or broken at the nexus of socially polarizing issues, where foundational aspects have an extraordinary importance. As it is well-known, this is an area where the authority of science does not go unchallenged. In fact, there are good reasons to worry that science might not be able to justify its social status in terms of its own accomplishments. On the one hand, several of its branches (e.g., quantum mechanics, statistical mechanics) are growing along paths that undermine the validity of the scientific method. If the claims of these theories about nature are true, then they cannot be confirmed with the established tools of science. On the other hand, there is still the problem of completeness of scientific interpretations of

the Universe. If the world is fully predictable by scientific means, and if the existing assumptions about physical laws are true, then fundamental human intuitions (about existence, reality, and free will) must be wrong.

As a corollary of the above, the future of democracy could very well depend on the outcome of the internal struggle, taking place in the mind of average voting citizens. Essentially, the problem is to decide what makes more sense: to support a not-so-democratic movement that promises meaningful existence and eternal salvation, or to stand for universal values that – one way or another – contradict their own foundations? According to some indicators, this process is already at work, at least in the lands of emerging democracies. For example, the most ardent supporters of radical fundamentalist movements are often found among the wealthy, healthy, and educated members of third-world societies. Political parties with anti-democratic aspirations are growing in popularity and even winning fair elections in many countries. Is it good enough to just hope that other factors will add up to a happy turn of events for the future of democracy? Should we rest assured that "good will" always wins? This is hardly a satisfying strategy for ensuring the progress of humanity.

This dissertation was inspired by the belief that foundations matter. At least as a matter of theoretical concern in political science, it is important to know if the status of scientific rationality can be understood with any measure of finality. The real issue for this project was the dependence of scientific rationality on the nature of leading scientific theories. Accordingly, the task was to determine if the problem stemmed from the actual properties of the observable world or merely from the details of their interpretation. The main result is the demonstration that scientific rationality is not doomed, because the

facts of nature do not undermine it. It is only the transient state of the current paradigm in science that leads to social head-aches. Significant changes in this regard can be anticipated, given a series of predictable developments in natural science. Therefore, it is too soon to dismiss the foundations of universal values in the modern world.

The walls of the modern mind

In a very general sense, human behavior is sensible behavior. One way or another, any human action can be connected to a prior intention that follows from an internal state. Perhaps, it might even be experienced as a chosen activity that "made more sense" than other alternatives, though it might be hard to justify it as such. Indeed, there are too many ways to ground a preference in rational terms, and things could also make sense for unknown reasons. Aside from our self-consciousness, the act of making sense might even be described as purely intuitive. However, such complications are not prohibitive for political science, where the main concern is *collective* action. In other words, only one type of preferences needs to be explained in this context: those involving groups of people. This simplifies the problem for two reasons. Firstly, individual decisions about other people must be based on communicable information. Relevant considerations had to enter individual awareness from outside, in order to motivate corresponding action. Secondly, public action is not reducible to isolated individual decisions. Social interaction is a process of massive mutual transformation, in which individual states of mind are entangled beyond any possibility of meaningful separation in terms of independent histories. Thus, individual quirks and idiosyncrasies cannot add up to a correct description of collective behavior. Instead, one needs to focus on the intelligible

concepts that generate consistent patterns of action for whole groups. Different individuals can only act in the same way, with some measure of regularity, if they make sense of their behavior in the same way. In other words, they must have common sense.

It goes without saying that common sense is only relevant for the understanding of voluntary actions. However, it defines the attitudes to all other types of action. Common sense does not require additional enforcement mechanisms. It is the natural foundation for structuring priorities and preferences. For this reason, any political project will require extraordinary means for its execution, whenever it does not resonate with common sense. The implication is that a social context cannot be changed with any finality, unless it is associated with a corresponding change in the content of ideas and principles that constitute the common sense. Indeed, the most profound transformations in the history of mankind are not produced by momentary outbursts, but rather by gradual changes in the repertory of things that make sense to the masses. For example, the medieval history of Western Europe is discontinuous from its modern age. Revolutions and social upheavals happened in many European countries (if not all) at the boundary between the two periods, but the roots of the modern age are not found in those events. Instead, we trace them confidently to the less violent developments at the break of the 18th century, which are aptly described as the period of Enlightenment.

In our days, the age of Enlightenment is summarily associated with the consolidation of the scientific method as a nuclear element of Western culture. This consequence is so important that it frequently overshadows the main feature of that period: the establishment of a philosophy of non-engagement in dogmatic value-systems.

Above all else, the Enlightenment was about intellectual freedom[1]. Of course, its impact cannot be separated from the work of its distinguished leaders. Nevertheless, the most convincing explanation for the success of Enlightenment is to be found in the extraordinary level of support that it enjoyed in the society at large[2]. In a sense, the ideas that shaped this transformation were in the back of the mind of average members of society, waiting for someone to give them a shape and a name.[3] Enlightenment is the quintessential example of a process that changed the substance of common sense, creating new patterns of interaction within and among various communities. For that reason, it can be used as a generic term for other similar projects.

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[1] The classical formulation of this inference can be found in the monography of Ernst Cassirer on *The Philosophy of the Enlightenment* (Princeton [1951], translated from *Die Philosophie der Aufklarung*, Tubingen [1932]). In response to various accusations of (scientific) dogmatism with regard to this philosophy, Cassirer clarifies its attitude to the laws of Nature as follows: "…we must not project our own ideas and subjective imaginings into nature; we must rather follow nature's own course and determine it by observation and experiment, by measurement and calculation. But our basic standards for measurement are not to be derived from sense data alone. They originate in those universal functions of comparing and counting, of combining and differentiating, which constitute the nature of the intellect. Thus the autonomy of the intellect corresponds to the pure autonomy of nature. In one and the same intellectual process of emancipation the philosophy of the Enlightenment attempts to show the self-sufficiency of both nature and the intellect. Both are now to be recognized as elemental and to be firmly connected with one another. Thus any mediation between the two which is based on a transcendent power or a transcendent being becomes superfluous" (p.45).

[2] In his seminal two-volume study on Enlightenment, Peter Gay provides an encyclopedic outlook on the numerous dimensions of this complex process. His study of the contextual details of this process are particularly insightful, especially his frequent emphases on the essential contribution of a large army of supporters and "helpers". An interesting example can be found in the discussion on Voltaire, in the second volume, where Gay notes: "The *philosophes* who read, memorized, distributed, and occasionally added to this literature were thus not lonely innovators. Rather they were gifted popularizers who used their literary talents to say what had been said before but not so well. Their atmosphere was saturated with rationalist propaganda. Montesquieu's *Lettre persanes* and Voltaire's *Lettre philosophiques*, the two most distinguished radical books published before 1740, found such a receptive public precisely because the ideas they expressed so wittily were so familiar. Indeed, when in the 1760's Voltaire mounted his great campaign to *écraser l'infâme*, he invented nothing. He merely brought out into the open a battle that had been fought underground for more than half a century" (p. 385).

[3] In the words of Victor Hugo: "No army can stop an idea whose time has come." (To be exact, this famous formulation is only paraphrasing the original sentence from *Histoire d'un Crime* [1852]: "*On résiste à l'invasion des armées; on ne résiste pas à l'invasion des idées.*")

The evolution of common sense appears to follow a pattern of punctuated equilibrium[4], in which cycles of stability are separated by periods of systemic readjustment. The need for change is determined by drastic changes in the environment, which undermine the validity of older rules and "thin lines". By all accounts, this is perfectly applicable to the realities of the present-day world. Globalization is the general term for all the changes in the structures of human interaction that result from rapid developments in the means of communication and transportation across the planet. Many concepts that made sense in the past are rather difficult to maintain in the new world. The main conundrum is that people seem to want the products of recent advances in technology, but not the implications of using them. The outcome is a troubling tension between the content of common sense, persisting from pre-existing communities, and the new contexts of existence. Indeed, globalization is more often discussed as a problem, even though the apparent motivation for the new technologies was to produce solutions.

Under the barrage of news about conflicts in the modern world, it may seem appropriate to define these troubles as essential components of globalization. On closer inspection, this sounds counterintuitive. Why should globalization be a problem, rather than a solution? Is it a law of nature that faster rates of communication should lead to confrontations? If Enlightenment is a relevant example, quite the opposite should be true. According to a very insightful study by R. Porter[5], the explosion of the printed media and the acceleration of social mobility resulted in a comparable information revolution in the

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[4] This concept was made famous by Stephen Jay Gould and Niles Eldredge who co-wrote the paper on "Punctuated equilibria: the tempo and mode of evolution reconsidered", (*Paleobiology*, v.3, 1977, pp. 115-151). It created waves of controversy in the field of evolutionary biology, but appears to be accepted by now. In any case, the concept refers to long periods of evolutionary stasis between shorter periods of outbursts in the rates of emergence of new species, in contrast to the model of a gradual and rather constant evolution. (http://en.wikipedia.org/wiki/Punctuated_equilibrium).

[5] Roy Porter: *Enlightenment: Britain and the Creation of the Modern World* (Penguin, 2000).

early modern England. Global trade exposed this British society to foreign cultures and financed the expansion of its economic infrastructure. Times of travel had diminished while the traffic volume increased, due to the construction of numerous paved roads. Most notably, this change resulted in an exponential increase in the quality and quantity of postal services, comparable to the contemporary jump from "snail mail" to "e-mail". In parallel, English coffee houses, pubs, clubs and lodges played a similar function to the chat-rooms and virtual communities of today. Witness accounts emphasized the remarkable democratic spirit of the new forms of public communication, in which traditional status considerations were downplayed in favor of "civilization through socialization". Perhaps the most impressive aspect of those transformations was the emergence of social and political activism as a mass phenomenon[6].

The "global village" of our time is also characterized by increased activism, but its aims and motivations are different. Whereas the social movements of Enlightenment were explicitly motivated by the search for a wider sense of identity, for common humanity across older lines of demarcation, the dominant forms of activism of today are aptly described as expressions of tribalism. Markers of increased cultural fundamentalism are easily found in various developments related to ethnicity, religion, and even in the power struggles of the global economy. To be fair, conservative reactions were not absent in the 18th century either. After all, peaceful reforms were the exception rather than the rule in Western Europe, when modern forms of government were established. However, the very fact that those transformations took place is a confirmation of the assessment

[6] "There were many Englands, but one was the stage of thrusting achievers, sold on science, dedicated to the diffusion of rational knowledge and eager for innovation – be it practical, artistic or intellectual. They were men devoted to the promotion of a new material well-being and leisure; aspiring provincials, dissenters, sceptics and political realists resentful at the traditional authority imbued in Church and State. Such moderns it was who were the fomenters of the Enlightenment." Roy Porter, *op. cit.,* p. 47.

that the need for change made (common) sense in that context. In contrast, the idea of a global convergence towards common perspectives on future transformations is not something that makes sense today. Perhaps not everyone is sold on the concept of inevitable clashes of civilizations, but there are no indications of radical new ideas taking root in opposition to anachronistic ideologies. The mere idea of a movement that could inspire people everywhere and give them a common sense of purpose sounds odd these days. This is not an attempt to disregard the nature of power relations that influence the attitudes to the globalizing forces. Rather, it is to point out that tribalism and universalism are equally valid sources of solutions for the problems of our times. Yet, only one of them is manifestly relevant today. This is a pattern that must be explained.

It is quite puzzling that the spirit of Enlightenment is not dominating the global politics of the 21st century, at any level of interaction. A possible answer to this problem was suggested – even if indirectly – by S. Bronner in a recent book on this topic[7]. Any large scale social process depends on the existence of a common conceptual foundation. The latter should be formulated by progressive intellectuals. Unfortunately, the relevance and even the basic meaning of Enlightenment are obscured by elementary misunderstandings in the community of social thinkers. Instead of trying to tackle the real issues, the intellectuals of today appear to be lost in pointless debates about speculative arguments that only seemed impressive a few decades ago[8]. *Reclaiming the*

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[7] Stephen E. Bronner: *Reclaiming the Enlightenment: Toward a Politics of Radical Engagement* (Columbia University Press, 2004).

[8] "Weak eyesight is precisely what results from the meta-political form of inquiry embraced by late critical theory and its postmodern acolytes. (…) There is no place for mediations or qualifications. A reactionary pseudo-universalism that is imperialist, racist, coercive, and irrationalist becomes conflated with a genuinely democratic universalism that is liberal, discursive, cosmopolitan, and critical. Each institution suffers equally from the impact of instrumental reason and there is never the genuine recognition that some institutions can expand or inhibit the range of free experience for citizens in ways others cannot. (…) Real conflicts thus get smothered in all-encompassing abstract categories and, because the "whole is false",

Enlightenment is a book that tries to fill this theoretical void by explaining the concept and its importance for our times. It puts forward a convincing and even motivational message, but its very existence raises an important question. Is Enlightenment just a great concept worth pursuing, or is it an idea whose time has come? If it is "in the air" now, just like it was three centuries ago, why should it matter that philosophers have conceptual troubles? Would it not have been pushed forward – by historical necessity – under a different name? Moreover, progressive literature is widely accessible today, from all over the world and from all historic periods. In the age of the omnipresent internet, one only needs to make a few computer clicks. If professional ideological leaders are missing, why do we not see their free-lance counterparts creating waves across the globe? Or is it that progressive leaders cannot find sufficiently large numbers of followers?

The modern world is not all about religious fundamentalism, just like it is not all about greed, or power. Indeed, by scanning the contents of various news outlets, one is likely to see well received speeches about universal values, numerous examples of philanthropy, stories about people volunteering to serve various high causes across the globe, as well as unprecedented numbers of organizations and institutions set up to support them. For all we know, even progressive political activities might be more intense than ever, despite being less advertized than the conflicts from all over the planet. It is also noticeable that a different sense of awareness about global issues is taking

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distinctions between regimes and movements become purely *ad hoc*. What remains is only an impotent and self-serving "negative dialectic" intent upon preserving the individual from a reified reality, emphasizing the "non-identity" between subject and object, and remaining open from the "totally other". (…) The theory of politics makes way for the politics of theory. Unable to deal with political institutions and social movements, incapable of drawing qualitative distinctions between intellectual phenomena, the critical heir of the Enlightenment ultimately collapses from exhaustion. Thus, it turns into merely another instance of what Thomas Mann called a power-protected inwardness". (*Op. cit.*, pp. 113-114). This passage is representative, but the book does not lump all theoretical approaches together. Different points of view are treated with requisite discrimination, yet their shortcomings are brought out with the same incisive style.

shape. With all of those new means of communication, average people know more about life in remote parts of the world than ever before. It would be a mistake to read the preceding paragraphs as a dismissal of such developments. The problem, however, is that all of these examples reflect events that do not add up to consistent trends, or at least not at the same scale as the other dimensions of globalization. New means of communication seem to produce nothing more than some newer forms of conceiving locality. Geographical borders are transgressed without significant impact on conceptual lines that separate groups of people. The world is changing, but common sense is not. If globalization is a problem, it is because people across the globe are easier mobilized to fight it than to embrace it. Insofar as there is a global trend in popular preferences (as least in the form of electoral results), it is in favor of conservative parties with local and protectionist agendas.

So, what is wrong with the mentalities of the modern world? The answer is found in the socially relevant standards of judgments regarding other people. In closed societies, information is limited and groups categorize each other according to stereotypes. Individuals are pre-judged for “who they are” (“where they are from”, “what they look like”, “what they wear”), rather than for “what they do”. In an environment with unlimited access to information such standards cannot work. Preconceived ideas are immediately challenged by routine experiences. Broad generalizations cannot survive under the pressure of particular facts. Therefore, new criteria for evaluation need to be used for mapping the social world. The common sense of “us against them” has to be replaced by some sort of basic recognition of shared humanity, motivating the preference for new and dynamic methods of context evaluation. Such a shift is simply necessitated

by the context of human interaction. Consequently, the puzzlement is not so much that modern mentalities fail to meet some sort of desirable criterion, but rather that they fail to respond to objective pressures exercised on them. In spite of ever-increasing opportunities to confront ideas with facts, empty stereotypes appear to be strengthened, instead of being dissolved.

This conclusion may sound too strong. Perhaps there are local reasons (pertaining to economic, cultural, political and other types of factors) which explain the mismatch between the "information revolution" and its effects. However, globalization is happening at fast rates everywhere in the world. If there are numerous isolated inputs that lead to the same outputs, it is at least likely that such causes are secondary, or epiphenomenal. The most likely explanation for uniform (non)reactions to contemporary trends in unrelated regions has to have a systemic nature. In other words, some element of the global cultural environment might be at work everywhere, constraining the evolution of common sense. In the interaction between globalization and common sense, we expect the former to induce changes in the latter. Therefore, the best place to look for a reason for the sluggish development of common sense is in the common sense itself.

Common sense emerges as a collective effort to make sense of the shared realm of experiences. If the content of old rules of interaction changes, it is because the world makes better sense according to new principles. In other words, any fundamental change in the content of common sense has to make common sense. If something makes common sense, then its opposite should not have the same validity. No system of values can be expected to justify its own demise. Consequently, changes in common sense are not necessitated by the main concepts that govern it, but rather by the analytical rules that

define its operation. The very intellectual process that makes it possible for common sense to emerge (i.e. the objective fact that different thinkers prefer the same analytical rules and can agree on similar conclusions from similar premises) becomes its main virtue during the times of adaptation to new realities. It is not a coincidence that Enlightenment was a period of unprecedented faith in the powers of reason. When old ideas are dead, and new ideas are not born yet, active rationality becomes the central concept of common sense, ensuring a meaningful transition. As Kant emphasized, there is a difference between an enlightened age and an age of enlightenment. The former may be just an ideal, but the latter is a time when people freely engage in public reason (i.e. in principled analysis, as if they were scientists)[9].

As a corollary of the above, the adequate response to the pressures of globalization should be a universal shift towards rationality, as a major component of common sense. It is not necessary for different communities to suddenly adopt common values and identities. Indeed, Enlightenment was not a homogeneous process in Western Europe during the 18th century. However, a massive enthusiasm for intellectual efforts to redefine the experienced world was at work then, and should be expected in the present as well. If this excitement (or the anxiety that fuels it) is channeled away from projects

[9] "The public use of one's reason must always be free, and it alone can bring about enlightenment among mankind; the private use of reason may, however, often be very narrowly restricted, without otherwise hindering the progress of enlightenment. By the public use of one's own reason I understand the use that anyone as a scholar makes of reason before the entire literate world. I call the private use of reason that which a person may make in a civic post or office that has been entrusted to him. (…)Thus an appointed teacher's use of his reason for the sake of his congregation is merely private, because, however large the congregation is, this use is always only domestic; in this regard, as a priest, he is not free and cannot be such because he is acting under instructions from someone else. By contrast, the cleric – as a scholar who speaks through his writings to the public as such, i.e., the world – enjoys in this public use of reason an unrestricted freedom to use his own rational capacities and to speak his own mind. For that the (spiritual) guardians of a people should themselves be immature is an absurdity that would insure the perpetuation of absurdities." Immanuel Kant: *An Answer to the Question: "What is Enlightenment?"* The text is in the public domain and freely available online (*e.g.*, http://philosophic.li/kant/what_is_enlightenment/).

that promote rationality, it has to be the case that rationality is discredited in some way that prevents it from taking the center stage. This hypothesis may sound paradoxical, considering that globalization is driven by a strong interest in technological commodities, which are only made possible by massive investments and wide-spread engagement in science. Yet, our world *is* paradoxical in this way: it is thoroughly dominated by concerns about science and education while it is largely uncomfortable with scientific rationality. Unless the role of rationality and its place in the modern world are properly understood, Enlightenment (or any progressive movement) cannot be more than wishful thinking.

There are many ways to define rationality, and there are different ways to be rational[10]. In the most general sense, any principled process of justification or explanation of preferences can be described as rational. However, all the different rationalities that were described by anthropologists and sociologists are demonstrably embedded in contingent social practices. Only scientific rationality has the privilege of context-independent validity. On the one hand, it has the intuitive appeal of seeming to be pre-theoretically valid, at least to the people who are actively engaged in it. This preference may seem contingent, but it is a demonstrable characteristic of any self-

[10] An instructive recent effort to provide a typology for rationality can be found in the concluding chapters of Lawrence E. Cahoone's *Cultural Revolutions: Reasons versus Culture in Philosophy, Politics, and Jihad* (Pennsylvania State University Press, 2005). He defines reason as "methodical metajudment" embedded in a cultural context, and spells out the differences between three broad modes of rationality: Durkheimian (ritual-segmentary), Jasperian (stratified-axial), and Weberian (modern-industrial). Perhaps they can also be distinguished as organic (motivated by the need to fit in the patterns of Nature), ideal (motivated by theological principles of transcendence), and efficient (instrumental rationality). All of them can be found at play in the modern world, and Cahoone emphasizes the advantages of a proper understanding of each type in its context. This work is, perhaps, a necessary improvement of Gellner's dual typology of reason, presented in *Reason and Culture* (Blackwell: 1992), yet the tradition of redefining rationality goes back to Max Weber. Cahoone has a good point that modern processes cannot be captured appropriately by the simpler distinction between Durkheimian and Weberian rationality, though every typology should be evaluated according to the context that demands it`.

conscious being that is able to entertain conceptual analysis.[11] On the other hand, the special status of scientific rationality is enforced by its empirical validity. The products of science are present in every aspect of modern life. The findings of science are valid at every place and time. Most importantly, no facts of Nature are known that could falsify the validity of the scientific method. Consequently, the missing "shift towards rationality" mentioned above is paradoxical because it refers to scientific rationality in an age of science.

How can be it that reliance on scientific rationality – arguably, the foundation of common sense – can fail to make sense as an instrument of social change in a world that is dominated by science? One possible answer is that scientific rationality (perhaps, like any other kind of reasoning) does not resonate very well with "matters of the heart". For example, the scientific description of twilight involves concepts such as rotating spheres, relative motion, sources of illumination, as well as angular momentum, coefficients, formal symmetry, and so on. None of these elements can be relevant in any way to the poetic experience of watching a sunset. Accordingly, rationality should have a limited sphere of relevance, able to provide nothing more than a parallel story about the facts that add up to the totality of human experiences. If so, the limited social relevance of rationality should not be surprising. However, this argument is misleading. Social interactions are all about actions and decisions, and these are unthinkable without the exercise of judgment. Moreover, the so-called parallelism between objective and subjective aspects of reality was not lost on the people of Western Europe in the 18th

[11] An argument to this effect will be presented in the second chapter of the dissertation.

century. Somehow, this “limited validity” was not an issue for them. Consequently, the explanation for the stated paradox must be found elsewhere.

The parallelism between subjective experiences and scientific interpretations is not a problem. Rather, it is a very helpful tool for the evolution of inter-subjectivity. Common sense begins with the articulation of shared experiences and even with shared acts of analysis. Unlike private experiences, social experiences seem rather impossible without a conceptual platform that is perceived as objective. The alternative would be some sort of capacity to connect human minds directly to each other. Yet, human communication is first and foremost conceptual communication. For this reason, rationality should be embraced for its power to provide a parallel description of subjective experiences. This function is so important, that only its absence would justify the need or the desire to disregard the products of rationality. Could it be that the progress of science has breached this parallelism somehow, undermining the social relevance of rationality? Is the proliferation of “tribal rationalities” a manifestation of disconnected local attempts to fill the void that is left by some failure of scientific rationality?

As a matter of fact, the progress of science has lead to a conflict between scientific rationality and common sense, in ways that were not anticipated in the early days of modernity. The main effect is the apparent demonstration that the world is not just intelligible – it is believed to be completely intelligible in terms of physical (and only physical) processes. In other words, science did not only provide a parallel description to the subjectively experienced reality. It managed to produce a description that eliminated the possibility of authentic subjectivity. If every known fact is reducible to material interactions, then conscious experiences (including rational and emotional processes)

must be epiphenomenal. The very idea of personal experience, which is essential for the understanding of subjectivity, is undermined in the same sweeping stroke that excludes the possibility of autonomous thoughts, reasons, decisions and actions. A material Universe is one in which everything is externally and objectively determined. Every conscious perception about the powers and abilities of the self can only be consistently explained as illusions of one sort or another. In short, scientific rationality is self-refuting. If one is committed to engage in it consistently, one must eventually draw the conclusion that such an engagement is impossible.

Another effect, which was even harder to anticipate during the European Enlightenment, is that scientific progress has undermined the intuitive concepts that pertained to the nature of the experienced world. The leading theories of modern physics are general relativity and quantum mechanics. Both of them display unprecedented predictive power, and therefore seem to offer the most accurate description of the Universe. Yet, their validity is restricted to their corresponding levels of analysis, and they are famously incompatible with each other (i.e. they make different predictions about the same phenomena). What they do have in common is their rejection of traditional notions of objectivity. According to the theory of relativity, any story about physical reality can only be valid from a specified context of observation. Different frames of reference can produce different descriptions for the spatial and temporal order of the same events, with corresponding causal accounts of physical reality. Yet, this is not interpreted as a mere state of knowledge about large-scale cosmic events. Rather, the Universe is supposed to lack an objective physical state that could be true regardless of the amount of available information about it. In the same vein, quantum mechanics

provides a strange account of unobservable microscopic phenomena, whose outcomes are measurable. This branch of science is particularly known for its insistence on the idea that multiple causative processes are simultaneously at work in Nature, even though human measurements can result in the manifestation of only one possible scenario. Intuitive concepts about objects with well-defined properties, able to interact with each other, have no place in this area of study, or else they lead to inaccurate predictions. Again, it is not just human knowledge about unobservable qualities that is imperfect. Reality itself must be described as a totality of interactions whose principle of operation cannot be grasped or visualized by rational thinkers (though, mathematical models can capture their essence).

Thus, rationality is not just an illusion, according to modern science. It is an imperfect and inefficient illusion, because it cannot justify its own existence, nor can it even reflect objective reality according to its true governing principles. It has this sorry status of a faculty that is supposed to help the operation of pseudo-agents in a narrow niche of experiential possibilities, even though this very operation can never be of any use, due to its epiphenomenal (i.e. causally ineffective) essence. Scientific endeavors may appear to be motivated by a commitment to scientific rationality. Yet, their outcome is an apparent demonstration of the absence of the essential ingredients for the very existence of rationality, or even its necessity. Though it is experienced as an essential property of human minds (especially by those engaged in it on a regular basis), scientific rationality is self-refuting, as far as current theories go. In conclusion, modern scientific rationality cannot be described as the source of a “parallel” description of the subjectively experienced world. Rather, it provides an incompatible description that serves to refute

the validity of this experience altogether. This conclusion is likely to be disputed by many people, especially scientists, but the foundation for such a position would have to be found in personal intuitions and "common sense", rather than in objective arguments.

Rational beings have always had the problem of deciding what to believe. Yet, Descartes has shown that rational self-consciousness is necessarily self-affirming[12]. The act of awareness of one's thoughts (and especially doubts) provides the foundation for believing that the self exists, for it is the self that is engaged in thinking. However, this conclusion is inseparable from the validity of deductive analysis. The only reason to believe that something exists at all (namely, the self) is grounded on the validity of this feeling of self-evidence that is associated with a set of elementary and intuitive logical principles. These are the principles that inform the scientific method in its entirety. So, what can a rational person do, if the same principles are shown to rule out its very existence? To doubt those principles is impossible. To deny their validity and utility in the face of overwhelming empirical confirmation is not a sound option. Yet, deciding that one does not exist is out of the question. Nothing else can possibly have any value, if such a step is undertaken. And so, the only way to lead a meaningful life under the cloud of such a conundrum is to draw a mental firewall between the things that belong and the things that do not belong to the realm of scientific activity. The old setting, in which scientific rationality was deemed to provide a parallel description of the experienced Universe as a whole, is now replaced by a context in which scientific rationality is confined to a specific activity (important as it may be) and separated from all others.

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[12] R. Descartes: *Discourse on the method and Meditations on first philosophy* (New Haven: Yale, 1996).

In the (not so distant) past, social activities could be called irrational, if they seemed to contradict the principles of deductive reasoning. In the present-day world, the opposite is true. The mind of every reasonable modern person contains a firewall, which allows existential facts to pass, but keeps the standards of scientific rationality in their place. When it comes to matters of personal or social relevance, scientific rationality is on the other side of the wall. This is the new common sense. One cannot reasonably care about life and commit to scientific rationality. Half-way commitment cannot work. It is simply self-evident, in the modern context, that scientific rationality is not appropriate for the analysis of non-scientific questions. Ergo, in all matters of social interaction, some other kind of rationality must be invoked. In practice, this means that public discourse is no longer subjected to mandatory principles of deductive analysis. Therefore, a void is left which must be filled by something. In fact, it is filled even before the existence of the void is consciously realized. Pre-modern systems of beliefs, with their rituals and institutions, are only too ready to be of service. It is not surprising that older systems of belief are currently surging to the forefront of social life, especially if they can be fomented by various interest groups. In the absence of valid critical scrutiny, radical messages can proliferate unchecked. The outcome is a growth of tribalism, and especially radical tribalism, because the minds of the masses are just there for the taking.

To sum up, the progress of science has created a world that is dominated by prescientific modes of rationality in most areas of human activity. What should we blame for that? Is this outcome a legitimate offspring of the project of Enlightenment? The answer can hardly be positive, since the problem is not reducible to the proliferation of impartial rationality, but rather to its banishment from the public sphere. On closer

inspection, these counterintuitive effects of scientific progress are found to be socially constructed. On the one hand, they can be traced to the belief that current physical theories describe the Universe completely. By implication, any and all human experiences should be reducible to physical facts. Yet, this is only an assumption, far from being conclusively demonstrated. On the other hand, the same effects are reinforced by the belief that the leading theories of our time (general relativity and quantum mechanics) are ontologically accurate just because they make correct predictions. This view is far from necessary, considering that the two theories are still incompatible with each other, as well as the long history of past theories with overstated implications. It is hard to say if these factors were avoidable, given the same historical circumstances, but there is hope in the knowledge that they can be remedied, at least in principle.

In a seminal book on the nature of scientific progress[13], Thomas Kuhn has shown that human knowledge grows discontinuously from the ongoing accumulation of facts about Nature. The rules of rationality demand the existence of a conceptually complete context for the meaningful development of scientific hypotheses. This implies that scientists are "forced" to come up with holistic theories about the Universe in an environment of limited knowledge, and this is what ultimately fuels and accelerates the process of discovery. It is a necessary element of good scientific research that questions should be meaningful, and this can only be ensured by an already defined conceptual structure. Thus, it is understandable that present-day scientists have the paradigmatic preferences that they do, but the social cost of this state of facts is growing at alarming rates in the environment of globalization. If cultural systems cannot adapt to the new

[13] T. Kuhn: *The Structure of Scientific Revolutions* (U. Chicago Pr., 1962).

realities, increased pressures from globalization can only lead to strife. Indeed, the argument in favor of the "clash of civilizations" hypothesis[14] derives its appeal from the assumption that such adaptation is not to be expected in the near future. Though, as suggested above, this capacity for change is not absent. It is merely hindered by some peculiarities of the latest paradigm that happens to dominate the sciences.

The contradictions of modernity were thoroughly investigated in the 20th century. The troubling mismatch between human intuitions about the world and the scientific conclusions about it has been critiqued and debated at least as much as it needed to be. Yet, most of these efforts were constrained by the terms of analysis that were established by the Frankfurt School and especially by the joint work of Horkheimer and Adorno on the *Dialectic of Enlightenment*[15]. These two thinkers captured the essence of modern problems so well that it was hard to disagree with them, and even harder to resist their explanatory choices. As a result, several generations of social thinkers felt motivated to interpret the evils of their times as some sort of necessary product of Enlightenment, even though this could only be achieved by misrepresenting its essence. Correct understanding can be counterproductive, if historical contingencies in the social or scientific realms are reified as dialectical necessities. Hence, Bronner[16] is right that these progressive thinkers have been missing the point. The problems of our time were not necessitated by the progress of scientific rationality. Instead, they follow from an unfortunate turn that this progress has taken. The course of scientific progress can be corrected, but only with the help of the principles that are the very essence of Enlightenment.

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[14] S. Huntington: *The Clash of Civilizations and the Remaking of World Order* (Simon&Schuster, 1996).
[15] T. Adorno and M. Horkheimer: *Dialectic of Enlightenment* (Stanford UP, 2002).
[16] *Op. cit.*

In conclusion, the evolution of common sense can catch up with the global social and economical developments of our time, but only if science can be expected to cooperate. In particular, it would be helpful to know if there is any reason to expect a paradigm shift in the near future, such as to restore the parallelism between subjective and objective descriptions of the phenomenal world. Unfortunately, there is no guarantee that the next paradigm will be more auspicious, even if it does take place. For all we know, it might be based on ideas that further expand the rift between human intuitions and human knowledge about the world. Yet, this process is too important to be left to its own devices. Political scientists need to do their own work, discovering appropriate tools for the understanding of pertinent social trends. In order to estimate the likelihood of favorable scenarios for globalization, it is imperative to find reliable indicators for any variable of interest. As far as the interaction between science and society is concerned, it would be counterproductive to wait for unpredictable discoveries, hoping that the experts will interpret them in the desired fashion. Some sort of independent standard is needed, in order to define a spectrum of possibilities for appropriate policy recommendations.

The goal of this dissertation was to develop a method for evaluating the possible impact of scientific developments on future patterns of social interaction. The primary interest was to determine if consciousness could ever be compatible with any kind of scientific facts. By knowing the material preconditions for the exercise of rationality, it is possible to judge if the apparent contradictions between scientific knowledge and human intuitions are dictated by facts, or merely by some sort of contingent interpretation associated with them. This goalpost was reached by undertaking a reverse engineering of rational self-consciousness. In other words, the essential components of rational self-

consciousness were investigated in a manner that unveiled the preconditions for their operation. It will be shown on the subsequent pages that this approach turned out to be successful. Not only is rational self-consciousness dependent on the fulfillment of a set of material preconditions, it is actually compatible with just the kind of physical facts that are confirmed by modern science beyond reasonable doubt. This means that the conflict between physics and consciousness is overstated. The facts of modern science do not exclude the possibility of human faculties. It is only the interpretations that lead to undesirable implications. Therefore, a paradigm shift in science could – indeed – eliminate the social problems that were described above.

The remaining question is: "How?" It might be reassuring to know that such a big predicament can be surmounted, at least in theory. Yet, this result cannot be satisfying, unless it can also point a way out, or at least a strategy for accelerating the process of change. As it is well known, scientific paradigms do not just come about for political reasons. New discoveries have to falsify existing theories, compelling a new generation of scientists to look for better alternatives. The unexpected benefit of the proposed method is that it has deduced the necessity of several physical properties (for the emergence of rational self-consciousness) that are incompatible with existing interpretive models in physics. These phenomena are verifiable and have yet to be tested. If they happen to be confirmed, it is reasonable to expect a paradigm shift in science, with significant effects on future social developments. The demolition of the firewall between human knowledge and intuitions can re-establish the social relevance of scientific rationality as the natural antidote to radical cultural fundamentalism. On the other hand, if those predictions turn out to be falsified by experiment, then the method proposed in this

dissertation will be disqualified. Ergo, it has the components of a good scientific theory. Far from being a speculative thesis about conceivable change, this work is a step towards a real solution, by attempting to close an unfortunate gap in the existing knowledge about the relationships between rational beings and material environments.

The bridge across the rift

The main body of the dissertation is an argument in three parts. The first one (Chapter II) deals with rational self-consciousness. The second one (Chapter III) is focused on the problem of free will. Finally, the third one (Chapter IV) deals with relevant issues in fundamental physics. Each part is conceived as a self-sufficient text, but they follow a single logical thread, and only together can they be relevant for political science. A general overview of the argument is presented below, as an introduction to the demonstrations that are explained in greater detail in subsequent chapters.

Students in political science are frequently cautioned against the temptation to treat different people in the same way. Some individuals might display numerous similarities, but human actions are motivated by idiosyncratic modes of thinking. Apparently, very few other sins in political theory are comparable to the assumption that all people think in the same way, even if they share the same cultural and biological heritage[17]. This emphasis on diversity is justified in many contexts of social analysis, but it seems unwise to follow it blindly. Our biological make-up accounts for many shared properties, though not all, and it is true that it cannot preclude diversity. Our cultural make-up is similarly unable to produce uniformity, even when shared, and it seems to

[17] For a recent list of methodological sins in political science, see "The 10 Conceptual Sins in Analyzing Middle East Politics" by E. Davis (http://new-middle-east.blogspot.com/2009/01/10-conceptual-sins-in-analyzing-middle.html).

account for most of those behavioral peculiarities that are irreducible to biological factors. Notwithstanding, there is also something about human nature that cannot be properly understood with genealogical analysis. To trace the history of a phenomenal manifestation (be it in terms of nature or nurture) is not the same as to understand its essence. Accordingly, some features of human behavior can be analyzed only with the tools of philosophy, because they do not belong to the proper realms of either culture of biology. In short, some human properties require exploration with universal concepts.

Consider the following example. Suppose that each and every human being has the ability to think, even if not all the time. Furthermore, suppose that every being that can think is also sure to believe that it exists, regardless of the amount of theoretical and experimental evidence to the contrary. Finally, suppose that this tendency enjoys a demonstrable necessary relationship with the ability to think. Given a proper understanding of the processes that underlie the ability to think, subtle as they may be, one must expect the associated behavioral trait (to take one's own existence for granted). It follows from these conditions that no amount of genealogical knowledge about the ability to think can enrich our understanding of its associated effect. Regardless of the evolutionary path that produced it, or of the biophysical elements that ensure its operation, the ability to think is impossible without the mentioned behavioral trait. As defined by the stated assumptions, it is impossible to come up with a counterfactual story in which the ability to think emerges without its associated quality. In fact, the only thing that matters is the hypothetical demonstration that one quality necessitates the other.

The sociological implications of such a relationship are remarkable. As long as it is impossible for thinking people to believe that they do not exist, this belief has to be

universally shared, in every cultural context, even those that happen to be completely isolated from the rest of the world. Should it be the case that the validity of this belief is called into question (even if motivated by well-grounded reasons), people would find it necessary to suspend their declarative support for it, without ever ceasing to endorse it. In other words, every thinker must be necessarily committed to the dogma of its own existence. Moreover, this dogma is indestructible and even reason itself cannot overcome it. This implies that the social construction of any value system must be constrained by such a factor. If some historical development were to result in the suppression of this belief, the cultural system in question would become unstable. As soon as the conditions can change, those incompatible principles are going to be discarded.

According to this hypothesis, common sense cannot be assumed to be composed exclusively of locally contingent norms and principles. It could also have a whole repertoire of pre-rational dispositions, universally shared across our planet. If so, it is worth knowing if the stated hypothesis can be verified, because of its high relevance for the proper understanding of present and future social developments. As stated earlier in this text, modern science has a tremendous authority, in light of its power to predict and manipulate the laws of Nature. This power translates into a lot of pressure on several human intuitions that appear to be universally shared. If it were possible to explain the indestructible commitment to those intuitions as a consequence of some other basic human feature, it would follow that the current popularity of radical ideologies is simply a response to the specified pressure. Thus, it would be incorrect to interpret the proliferation of cultural fundamentalism as a confirmation of the theory about inevitable “clashes between civilizations” in the modern context. Moreover, a favorable change in

the content of the dominant scientific paradigm could have a global social impact, because of the universal nature of the underlying factors.

This problem is going to be addressed in the following chapters by focusing on the relevant dimensions of rational self-consciousness. For clarity, the word "rational" is used as a qualifier for the active conceptual affirmation of self awareness. A thinking subject could be passively aware of various feelings and thoughts. Hence, the specification that one can be rationally self-conscious is meaningful, as it isolates the explicit and adequately intended act of self-affirmation. The main idea is that a person cannot formulate or even grasp the concept of self-consciousness, without also believing that other relevant qualities are true. Yet, the same person can only actively record its thoughts as its own after realizing that it is a rational agent. Hence, the reasons and conditions that justify the belief in one's awareness can only be experienced as hardwired intuitions, i.e. as something to be taken for granted. In other words, a person "just knows" of its own existence, and it "just knows" that a few other things are true. Much like socially constructed beliefs, these intuited facts are employed dogmatically, but they are universal to the extent to which rational beliefs about self-consciousness are universal. Remarkably, the capacity to express one's awareness cannot emerge outside of a social context. Strictly speaking, it is also socially constructed. However, it could be true that humans are rational agents[18], in which case all of the associated beliefs must be true as well. Accordingly, the hope for an auspicious paradigm shift in science is grounded on

[18] In the absence of *a priori* knowledge about existence, skeptical arguments have to be given their due. For all we know, rationality could be an illusion, which would imply that human beings might not be what they think they are. Yet, this is not a good reason to assume that humans are necessarily not rational. Thus, it is a reasonable step to assume that we, as humans, might be correct about our reality, and it is worth inquiring what such a step would entail.

the assumption that rationality is not an illusion, in which case its universality is dictated by objective factors, and scientific facts should be demonstrably compatible with it.

Given the details of the human experience, rational self-consciousness appears to be an emergent property. Children seem to be born without it, and then acquire this faculty through a developmental process. Rational self-consciousness cannot be described as emergent without specifying a set of necessary conditions for its emergence. The fundamental action that establishes the emergence of this faculty is the willful and meaningful assertion of the acting self ("I am", or "I think"). For this action to be more than just an illusion, the thinking subject must be an autonomous agent. Intentions have to be real, they have to be really expressed, and the power to assign meaningful connotations to well-defined concepts must be objective. The power to express a specific intention with contingent symbols requires the actual existence of agency. Hence, to be rationally self-conscious is to exercise free will. A thinking subject cannot verify the reality of its faculties immediately. It may or may not be true that all of those faculties are real. However, the statement "I am" is meant to express a mental state, as well as the belief that such a statement is true. A subject cannot believe the statement without also believing that the necessary conditions for its veracity are also true. Accordingly, to believe that "I am" and not to believe that "I have free will" is a flagrant contradiction.

This is a remarkable conclusion, because it brings out another important issue. The risk of contradiction is frequently perceived as a strong reason to avoid one statement or another. But why should it matter that contradictions are present or absent in thinking? Can they be independently justified? Human preference for logical consistency appears to be based on mere intuitions. The answer follows from the following realization. The

statement that “I am” can only be meaningful in the context of a well established system of references, with corresponding rules of operation. Without a working principle of deductive exclusion, the notion of “I” cannot be meaningful, because it is co-determinant with its opposite (“non-I”). A thinking subject must first commit itself to an appropriate system of logical analysis, and only within the boundary of such a system can it formulate meaningful autonomous statements. Therefore, the operation of rational self-consciousness presupposes the validity of deductive logic. No subject can doubt the validity of such logical rules, without undermining the means for meaningful self-affirmation. If rational self-consciousness is an emergent property, then a belief in free will and a commitment to deductive logic must pre-date the act of emergence. All self-conscious thought must follow after this turning point. Consequently, a rationally self-conscious agent has no choice on this matter: beliefs in free will and in the absolute validity of deductive analysis must be taken for granted. They are experienced as mere intuitions, but they are not accidental properties. As long as the subject is engaged in active rational analysis (which presupposes rational self-consciousness), these two properties are (synthetically) a priori valid.

The experience of rational self-consciousness cannot serve as a marker of its own reality. It could be true, or it could be false that a subject is a true agent, given the same sensorial content that is perceived as willful mental activity. Nevertheless, the meaning of the statement “I am” cannot be ambiguous. Regardless of its veracity, it expresses only one meaningful belief – that the subject is rationally self-conscious, as a matter of fact. Whenever an act of self-affirmation takes place, the validity of the preconditions for its emergence is presupposed. Moreover, any act of willful deliberation is relevant only if it

is pursued by an agent. The alternative would imply the possibility of willful actions without agents, or else that mental activities could have any purpose in the absence of the intended will of the agent. Thus, any purposeful mental activity requires the operation of rational self-consciousness. If rational thought in general can be defined as purposeful mental activity, then it cannot unfold without presupposing the validity of classical logic (coherent with the principles of deductive exclusion) and free will. This means that human intuitions about deductive analysis cannot be described with satisfaction as evolutionary contingencies. No other developmental avenue could have produced rational beings without intuitive predispositions for classical logic, or without a tendency to believe in the reality of free will. On the other hand, alternative evolutionary paths could have produced beings with the illusion of rational self-consciousness, in which case the preceding conclusion does not apply. Therefore, it is of paramount importance to determine if the validity of rational self-consciousness can be verified a posteriori.

The existential dimensions of rational self-consciousness can be understood by expanding the list of its necessary preconditions. On closer inspection, it turns out that one cannot affirm the existence of anything in the absence of objects of perception. Something has to be perceived before it can be meaningfully described as extant or not. Despite the Cartesian rejection of everything doubtful, one cannot possibly realize that one is thinking without having thoughts, yet thoughts must be about experienced inputs, even as they are received through fallible means. A thinking subject is perfectly justified to doubt the content of available memories, concepts, and perceptions, but it is impossible to have doubts about them in their absence. As suggested above, the rational affirmation of the self can only happen in a well-established context. This has to be a microcosm in

which a whole set of operation is already in place, and it has to include rules of analysis, free will, as well as corruptible memories, concepts, and perceptions. If rational self-consciousness is ontologically valid, and if it is an emergent property, it has to come about after the fact of existence of its preconditions. Strictly speaking, the world can never be more than an imperfect projection for a rationally self-conscious being, because it is the reflections (and never their source) that provide the ground for self-affirmation. The self cannot be described in primordial terms, as if it could have an essence beyond the contingent details of observation that produce its emergence.

The rationally defined self can only emerge on the basis of phenomenal observations, without direct knowledge about noumenal facts. However, it takes a special configuration of noumenal and phenomenal elements to satisfy the preconditions for rational self-consciousness, especially when they have to account for the operation of free will and deductive analysis. The details of these requirements indicate, as shown in the subsequent chapters, that rational thinkers cannot meaningfully distinguish between "real" and "unreal" phenomenal worlds. They can only discriminate among sensorial realms on the basis of their authenticity. The world is always "like a dream" for rational observers, but rationality is not always compatible with the experienced world. The necessary congruence between rationality and its constitutive phenomena is only guaranteed for the process of emergence. After that, the only option is to inspect the appearances, deciding to trust them if they are compatible with the preconditions for rational self-consciousness. In other words, the necessary intuitions must be found to be

in agreement with the contingent knowledge about the observed world.[19] If not, something must be wrong with the world, or else self-awareness must be illusory.

This understanding of rational self-consciousness can be defended against both types of radical skepticism, Cartesian and Humean alike. Given the essential function of appearances, they cannot be dismissed for their fallibility. Instead, one should focus on their governing laws and principles. Descartes was close to this rule when he emphasized the need to rely on the intuitive sense of clarity[20]. However, there is no need to invoke a supernatural guarantor for this rule (and the circular arguments that such an invocation would entail). Rational self-consciousness is either true or false. If it is false, then nothing relevant follows from the mistaken assumption that it is not. If it is true, then its preconditions must have been satisfied. Ergo, the world had to conform to the relevant principles for emergence. If the appearances do not correspond to those principles, then the experienced dream-world is inauthentic and morally inconsequential[21]. Reliability does not follow from the essential properties of objects in themselves, but rather from the observable laws that govern their organization and operation. This means that the only way to test the authenticity of the observed world is to study it according to the principles that allow for rational self-consciousness, i.e. scientifically.

Similarly, Humean skepticism can be overcome by defining its boundaries. Induction is neither necessary nor sufficient to account for the emergence of some

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[19] Necessary intuitions are those that reflect the preconditions for the emergence of rational self-consciousness. Though experiences cannot distinguish between habitual intuitions and necessary intuitions, the latter can be justified with rational arguments, since they are synthetically a priori valid whenever rational self-consciousness is true.

[20] R. Descartes, *op. cit.*

[21] Authenticity describes the fitness of an experiential environment for a rational agent. Instead of asking: "Is this world real?" one is concerned with a different issue. Namely: "Is this a world in which the exercise of rationality is reliable?"

assumptions about the observable phenomena. The most important set of beliefs about the world (especially those about causality and intelligibility, which are so important for the exercise of science) might be at work even before the act of self-conscious observation. Most likely, they are acquired through a combination of factors, deductive as well as inductive (perhaps even with external assistance, e.g. from parents or tutors), all of which are "on the other side" of the point of emergence of rational self-consciousness. Though intuitively grasped, they reflect the synthetic a priori principles that govern the emergence of autonomous thought. To doubt the validity of these necessary intuitions is to doubt the existence of the very rationality that informs the scientific exploration of the Universe. If a property is real, its necessary conditions must be real too. The only exception would be to assume that rational self-consciousness has emerged successfully in one realm of existence, only to be somehow transposed into an illusory environment. In any case, it is incoherent to believe that the necessary intuitions for rationality could be wrong. Ergo, Humean skepticism has a limited relevance. The necessary preconditions for the emergence of rational self-consciousness imply that the world must be intelligible by human observers in terms of the same types of concepts that make the definition of the self meaningful. This entails that classical scientific principles about causality, locality, energy conservation, and well-defined entities should be sufficient to explain every possible observation in a realm of authentic phenomena. If these principles should fail, the world and/or rationality must be treated as illusory and the pursuit of science as meaningless. Therefore, it is not possible to have a useful alternative to the principles that were used to establish the methods of classical science.

As a corollary of the above, skeptical arguments about the nature of phenomena and/or about the nature of rationality can be given satisfactory answers on the basis of empirical observations. From this point of view, scientific investigations should be motivated, at least in part, by the need to test the compatibility between the laws of Nature and the necessary intuitions of rational thinkers. As it is well known, human knowledge seemed to advance towards a definitive confirmation of such congruence, up to the beginning of the 20th century. Yet, the emergence of quantum mechanics and relativity, as well as the cultural and social processes that developed in parallel with them[22], have broken this trend. By now, skepticism about the origin of human intuitions appears to have morphed into professed certainty about their inadequacy. The sources of this attitude are two-fold. On the one hand, adherence to classical intuitions about Nature was slowing down the rate of theoretical progress in physics, in contrast to the fast pace of experimental developments. On the other hand, the status of those intuitions was called into question by new trends in anthropology and biology, with their emphasis on "social constructivism" and "evolutionary psychology" respectively. The problem with this turn of events is that science, as a project, has become self-defeating. As shown above, the new views imply that the observable Universe and/or the capacity for autonomous thinking are illusory.

The attitude that human intuitions might be accidental is not exactly problematic. It simply reflects the tendency to treat all conceptual predispositions as habitual (and, undoubtedly, many of them are). Yet, this approach cannot be regarded as reliable, because it ignores the priority of the necessary intuitions relative to the exercise of

[22] World wars, massive industrialization, totalitarianism, post-modernism, mechanical proceduralism, despiritualization, etc.

scientific rationality. Much more serious are the objections of modern physics to classical views about Nature. After all, the nature of reality (and rationality) is supposed to be verifiable with empirical observations. If the laws that govern fundamental physical interactions were to reject the possibility of rational self-consciousness, then no further appeal would be possible. That is why it is of paramount importance to know: what element justifies the rejection of classical views about Nature? Is it the raw facts or merely their interpretation that point that way? These questions cannot have an immediate answer, because there is no standard for their adjudication yet. Despite the strength of opinions on this matter (in any direction), there is no list of necessary material facts that could be invoked to decide which view is supported by empirical data, or even if the data is sufficient for a decisive answer.

In order to find a way out of this conundrum, rational self-consciousness must be investigated at a deeper level, aiming to derive its material preconditions. For the purpose of this project, the chosen strategy was to investigate the necessary conditions for the exercise of free will. Rational self-consciousness requires free will for its objective emergence, and no other faculty was found to depend on the interaction between matter and consciousness more directly. Yet, modern philosophers are still undecided if the concept of free will can be properly defined, without committing any conceptual fallacy. This difficulty stems from the apparent inability to provide a causal mechanism for free will, such that it is both relevant and meaningful. It should be noted, however, that free will is traditionally investigated as a stand-alone property. Presumably, it would be a trivial matter to "add" this property to the description of any other mechanism (mental or otherwise), if it could be properly defined as an autonomous process. On closer

inspection, this approach does not seem to be very promising, given its recent history. In contrast, it seems more appealing to analyze free will just as it presents itself during introspective efforts: as an inseparable element of rational self-consciousness.

In essence, self-consciousness is a concept that describes the propensity of a subject to be aware of its will. This statement is derived from a model of the mind that can be summarized as follows. Physical signals about external states enter the mind with competing demands for action. These signals are processed, and one of them is favored, according to a pre-existing principle. The latter is a programmable quality, subsequently described as "the sense of self"[23]. The verdict of the sense of self becomes the command for the appropriate action. As described, this could very well be a deterministic mechanism. However, it is also possible to replace the directive for action with a metaphysical interface. The trigger for action could be a physical indeterminate process, whose outcome is decided by the non-physical intervention of the will, somewhat like a behavioral law of nature. The will must always reflect the state of the sense of self, and plays no other part except to guarantee that the course of action has an opening for autonomous directives. If a subject were to become aware of this opportunity, then it could also use it for its own ends, effectively becoming an agent.

The will must always be determined by the sense of self, or else it cannot be relevant as an attribute of the agent. In this sense, the will is never free. However, external inputs have parameters that are directly dictated by the environment. Some directives come with a stronger sense of urgency than others. The sense of self, in contrast, decides which input becomes an output on the basis of independent principles.

[23] This is based on the description of the governing principle along the lines of "I do this, because I am the kind of being that always does this".

There is no reason to expect the stronger demand to become an action all the time. In this sense, the will is instantaneously free (i.e. free from immediate environmental pressures). Still, on a larger temporal scale, this does not imply freedom from determinism, especially if the sense of self is shaped by earlier experiences in the same environment. Hence, this model is not enough to justify the description of the will as autonomous. The latter can only be the case if a subject, having acquired rational self-consciousness, supplies its own directives for action, and initiates activities that end up changing the principles that govern the sense of self. In short, free will cannot emerge without the intervention of agency, but the latter cannot emerge without the existence of "potentially free will". Free will and autonomous thought are co-dependent properties, because the capacity for thought becomes autonomous due to the effect of the potentially free will, and the latter becomes actually free as a result of actions motivated by the products of rational analysis.

Rational self-consciousness is the mental quality that imposes the description of the will as a metaphysical element. As presented above, the will might seem dispensable in favor of a mechanical switch. Yet, rational self-consciousness, as a physical process, cannot reflect another physical process. Such an assumption leads to infinite regress or meaningless models. The unavoidable assumption is that rational self-consciousness is a process that translates metaphysical states of awareness into physical operations. In other words, physical inputs into the mind must be accompanied by some sort of immediate (non-physical) awareness, informing the will (or else acting directly as the will). As a parallel operation to this metaphysical process, rational self-consciousness does not lead to conceptual problems. It describes what it is supposed to mean: a conceptual

representation of its immediate awareness. Yet, this translation into a physical process of a metaphysical state can only work through the effect of the will. In this model, physical processes are governed in their indeterminate behavior by determining directives from the sense of self. Hence, rational thought can operate within the boundaries of its necessary and self-sufficient deductive rules, but only as long as the will to continue this work is effective. In practice, one has to focus on a mental operation, in order to complete it. The autonomy of reason follows from its independent rules as much as from the effect of the will, because the governing sense of self is not fixed. At first it needs to be shaped from outside until it can translate feelings continuously into concepts. With maturity, personal decisions become the exclusive set of factors that shape the sense of self through interactions with the external world. By acquiring control over the sense of self (or at least the potential for it), rational self-consciousness ensures its own autonomy.

The problem of free will has been the subject of numerous debates, in particular with regard to its compatibility with determinism. For this reason, it is worth pointing out that the model of mind summarized above has many deterministic features. The sense of self dictates the choice of any action. It is shaped by the environment at first (through physical, as well as informational effects), and subsequently by the directives of rationality. Even in the latter case, the role of the environment cannot be ignored. Hence, this is not a model of freedom in which a rational being has the real power to act on random intentions at the moment of decision. Rationality is autonomous in the sense that it can operate according to its own principles. Moreover, it can produce courses of action that change the sense of self in time, through sustained efforts. This means that future states of the sense of self can be shaped by the rules of the reason, while its present states

are not fully reducible to deterministic effects of the existential environment. In this sense, the rational being is autonomous from its material context. Were it not for the need to provide a coherent description of rational self-consciousness, this could be a purely physical model. As it is, the model has to contain metaphysical elements, but only in cooperation with appropriate physical properties. This means that free will requires a physical environment with exceptions to local determinism, in order to operate as a non-physical trigger for action in chosen directions.

As a corollary of the above, the capacity for free will cannot be exercised if physical laws are sufficient to determine all physical events. Some outcomes should be determined by the intervention of the will. However, it is also the capacity for free will that requires unfailing physical laws. It is not enough for this faculty to be functionally possible. It has to be useful as well. A rational agent needs to be able to make correct predictions about the evolution of its environment. Assuming ideal conditions, when the laws of Nature are perfectly suited for the exercise of free will, there should be no exceptions to the observable patterns of material interaction[24]. Only this can guarantee that a decision is grounded on reliable projections about the effects of an intended action. Yet, the net effect of these two requirements is a conundrum: free will requires unfailing physical laws, as well as exceptions to such laws in the behavior of material entities. This conflict informs the age-old debates between libertarians and necessitarians on the nature of free will[25]. Both camps are right in insisting that one of the two properties is essential, but the belief in their incompatibility forces a choice in favor of one quality only.

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[24] Ideal conditions have to be assumed, because the purpose of this exercise is to determine the types of observable properties that might confirm the possibility of free will.

[25] An overview of this debate is presented in the addendum on *Groundwork for Chapter III*.

Libertarians prefer to give up the requirement for determinism, while necessitarians (known in the current literature as compatibilists) choose to hold on to it.

It is counterintuitive to insist on any one property, to the detriment of the other, if both of them are required for the exercise of free will. For this reason, it is more practical to solve the conundrum. The most appealing solution is to adopt the principle that physical laws should have zero exceptions, without being sufficient to account for all the possible physical events. Ideally, even events that are not physically determined should come about without contradicting any deterministic physical law. The price for this requirement is to define physical determinism as a macroscopic manifestation of lower-level laws of Nature, where metaphysical factors are allowed to influence the behavior of material entities. Such factors must be constrained in their scope, and should not be able to influence the interactions between material entities, except in predictable configurations. It will be shown in the chapter on free will of this dissertation that such a solution is possible, and it leads to clear implications about the observable physical properties that must be compatible with the exercise of free will. Specifically, the architecture of matter must have a fundamental level with discrete indivisible entities, whose parameters are constant and indestructible; the interactions between elementary entities should take place in a solid elastic medium; and, finally, the elementary units of matter should act as sources of energy. An additional criterion is for the fundamental properties and interactions to be intelligible within the same conceptual rules that are used by rationally self-conscious beings to understand their own existence.

It was very useful, for the purpose of this dissertation, to derive a list of verifiable physical pre-requisites for the exercise of free will. Unfortunately, these particular

properties happened to be rejected by contemporary interpretations in the science of physics. The corresponding task was to determine if they were still compatible with the known facts of physics. As shown in Chapter IV, a fundamental level of material organization requires the observation of theory-independent constants in the dynamics of elementary entities. Such parameters are, indeed, known to exist (e.g., Planck's constant and the speed of light). The hypothesis that elementary entities could act as sources of energy was used to develop a model of quantum interactions, which is in good agreement with the known facts of quantum mechanics[26]. The only property that seemed to be ruled out explicitly by the experimental record was the hypothetical existence of a solid elastic medium. Yet, a closer analysis of the relevant observations has shown that this is not the case. The Michelson-Morley experiment and its variants were apparently based on a falsified assumption, which was also incompatible with the facts of quantum mechanics. The hypothetical existence of a universal medium should be tested again, by studying the rate of propagation of changes within static electric and magnetic fields. This outcome suggests that modern physics still lacks important bits of evidence about relevant physical properties for the discussion of rational self-consciousness. New tests should be performed, which could be used to decide if free will is possible in our Universe (and, by implication, to validate the authenticity of observable phenomena for the exercise of

[26] The list of the representative publications on this topic include: 1) "What is a photon?", presented at the Conference on *The Nature of Light: What Are Photons?*, part of SPIE Optics & Photonics, San Diego, USA, August 2007 (Proc. SPIE, vol. 6664, p. 66640X:1-9). 2) "Understanding quanta beyond quantum mechanics", presented at the Conference on *Quantum Theory: Reconsiderations and Foundations – 4* at Vaxjo University, Sweden, June 2007 (AIP Proc., vol. 962, p. 286). 3) "Qualitative insights on fundamental mechanics", presented at the Third Feynman Festival, hosted by the University of Maryland, USA, in August 2006 (IOP: Conf. Series vol. 70, 012012). 4) "Interpreting negative probabilities in the context of double-slit interferometry", presented at the Conference on *Foundations of Probability and Physics – 4,* hosted by Vaxjo University, Sweden, in June 2006 (AIP Proc., vol. 889, p. 341). 5) "What is a quantum really like?", presented at the Conference on *Quantum Theory: Reconsideration of Foundations – 3,* hosted by Vaxjo University, Sweden, in June 2005 (AIP Proc., vol. 810, p. 360).

rational self-consciousness). Existing facts are insufficient for decisive answers, either for or against this possibility, but they are still compatible with it.

Until the recommended experiments are performed, it is only possible to speculate about their likely outcome and impact. Though, only one of two results is possible. If the experiments refute the validity of rational self-consciousness, then science will continue to advance within its current paradigm, while scientific rationality will remain at the same low level of relevance for the social developments of the future[27]. In the opposite case, a sequence of dramatic changes can be anticipated, given the arguments presented above. At first, such novel results will simply demand additional efforts for replication and deeper investigations. Upon sufficient confirmation, new interpretive models would have to be developed, because existing ones will be falsified. The formalism of quantum mechanics and general relativity will not lose their validity, but the status of these theories as accurate descriptions of reality would have to change. This means that relevant philosophical theories about the interaction between mind and matter would have to be updated too. These developments are likely to reach a stage when it will simply be a matter of public knowledge (given the corresponding consensus in science) that human intuitions about the world are in perfect agreement with the scientific understanding of the Universe. This outcome would be sufficient to restore the relevance of scientific rationality outside the domain of science.

Beyond this general conclusion, the details of the presented derivation have yielded new concepts for the study of cultural change. The capacity for rational self-consciousness emerges with pre-theoretical intuitions about the experienced world, as

[27] Philosophically, of course, this outcome is undesirable, because it implies that our shared world is an illusion.

well as with a lack of knowledge about it. Compatibility with any phenomenal context is not guaranteed, but it must be established for the proper exercise of rationality. Therefore, it is a pre-requisite for human beings to have cultural paradigms that codify their fitness to any experienced context of existence, in the same way in which scientific paradigms were shown by Kuhn to be essential for the pursuit of science. In short, rational beings have necessary intuitions about the world and insufficient knowledge about it, while cultural paradigms mediate the relationship between these two conditions. The interplay between contingent cultural elements and necessary intuitions explains the complex nature of common sense. It also predicts the necessity of paradigmatic shifts in the content of common sense, whenever existing assumptions about the world are contradicted by new realities (be it patterns of interaction, or brute facts). If cultural paradigms fail to mediate properly between intuitions and knowledge, they only distort the perception of the world. Ergo, they must be discarded whenever a better alternative is available. However, change cannot be instantaneous. According to the described mechanism for the development of self-awareness, habits of thought can only change with great efforts. Just like in science, old paradigms are not given up by their devoted supporters. It is only the younger generations that can make a true choice, because they have no prior commitments. Thus, cultural paradigms can only be replaced gradually, but still within the lifetime of the first generation that is born after the establishment of the new alternative.

As shown above, rational self-consciousness depends on the fulfillment of a set of physical preconditions for its reality. Some of these conditions have yet to be confirmed conclusively, but they are verifiable with the existing tools of science. This means that an

answer should be expected in the near future. If the suggested experiments happen to uphold the validity of rationality in our world, scientific paradigms would have to change accordingly. For the processes of interest for political science, the relevant outcome would be the establishment of a consensus that human necessary intuitions about the world are compatible with the existing knowledge about the world. Yet, this knowledge would not be compatible with the existing cultural paradigms. The content of common sense would have to change. Of special interest is the universality of the anticipated consequences. The specified intuitions are shared by all rational beings, and the relevant knowledge will be universally valid, given its scientific character. Therefore, the evolution of common sense across the planet will unfold along common rules and concepts, allowing for the possibility of a shared foundation for the new cultural paradigms. This means that the "global village" will have the means to acquire a matching global culture. This is not something that can be expected automatically. Nevertheless, the preconditions for a new age of Enlightenment will be fulfilled.

II. TRUE REALITY AND RATIONAL SELF-CONSCIOUSNESS

Abstract: The goal of this chapter is to derive a method for contextual discrimination among existential (phenomenal) realms in terms of true reality. It is shown that rational self-consciousness corresponds to a third-order level of reality, subordinated to the second-order level of perceptions, which may reflect a first-order (absolute) reality. Existential realms correspond to second-order reality, and they can be described as true when they are capable to provide a proper connection between first-order and third-order reality. The unique features of this link can be used to distinguish between two different types of reality on the basis of observations alone.

Towards true reality

When it comes to questions about the nature of reality, nothing short of certainty is completely satisfying. The world is either real or it is not. If so, there must be a way to find out the truth about it. Unfortunately, it seems to be impossible to get foundational answers from inside a process without running into circularity or infinite regress. Therefore, it is worth looking for an alternative methodology in the quest for certainty about reality. Instead of striving for answers with universal validity, it may be easier (and equally satisfying) to look for solutions that apply to the human context alone. Reality may or may not be distinguishable from illusion at all times, but it is conceivable that some contexts could have revealing properties with unambiguous implications.

The value of any conclusion depends on the quality of its premises. However, if one uses the highest conceivable standard of knowledge, which demands exhaustive

justification for everything, then knowledge acquisition becomes impossible. The first elements of any argument must be justified before they can be used, but they have to be used in order to justify anything. This vicious circle is sufficient to deflate any expectations about rational truths with unshakeable validity. Still, it is not enough to rule out the possibility of contingent contextual answers. After all, the goal is to investigate questions that are already meaningful in their own context. The rules for meaning-attribution may be arbitrary, but they only need to be coherent for the question to make sense. Accordingly, it is an acceptable compromise to look for practical answers that make sense in the same context in which the questions were asked.

The groundwork for rational analysis, using the highest meaningful standard (as opposed to the highest possible standard), was laid for us by Descartes[28]. This is particularly relevant, since it was actually developed for the problem of reality, as experienced by human beings. After peeling away every element of the world (and of the self) that is not completely certain, Descartes has shown that only one such element remains for a rational thinker. *Something* must necessarily exist, if even the most radical skepticism is to be tenable, and it must exist in a manner that makes possible the thought process that has lead to the quest for truth. This absolute "something" is proven to exist by direct deduction, and therefore is acceptable as a certain fact. However, it is the only such fact, without any clue as to how everything else derives from it. It does not even imply with necessity that I – the thinker – with my present particular identity, must exist as such. Understandably, Descartes needed the help of a benevolent supreme agent to bridge this gap. However, the reality of divine protection is not proven by him to be

[28] René Descartes, *Discourse on the method and Meditations on first philosophy* (New Haven: Yale, 1996).

universally certain. In fact, it appears to be contingent on the accident of one's beliefs about divinity.

To be sure, the conclusion that "I exist" is available by indirect deduction, because the statement "I do not exist" is self-refuting. However, it is a vague conclusion, condemned to be true under any circumstance. If I dream that I am a butterfly (or any other creature), it holds just the same, as long as I utter the statement. In fact, it is precisely the indeterminate nature of this type of conclusions that motivates the question: "Which is the true reality (if there is one), and what is my true identity in it?" It may appear that only a demonstrated causal link between Descartes' absolute something and my identity is satisfactory. But this is not the case. The link can be assumed, and accepted without demonstration, as long as its effects are confirmed with certainty. Consider the following argument:

1. A is sufficient but not necessary to produce B.
2. Whenever A causes B, the emergence of C follows with necessity.
3. C cannot emerge in the absence of A.
4. Whenever we have B&C, A must be the case.

This line of reasoning suggests that it is possible to obtain certainty about the nature of reality in some contexts, without knowing exactly how it connects to the established foundation. If only true reality had some sort of exclusive and unmistakable property, it could be validated by an act of contextual observation. The problem is that the outcome of such a test depends on chance. If the observer is lucky to experience C, then reality is validated as true according to a scenario that follows from the foundation A. In the absence of the experience, it may happen that C is the case without being

properly observed, or it may be that reality is true according to some other foundation D. Of course, it may also be the case that the experienced reality is illusory. Thus, one can only hope for certainty in the case of irrefutable evidence in favor of C. Nevertheless, this method is quite appropriate for the human context, where the main task is to verify a set of intuitions about a specific manifestation of reality. In particular, I have a strong intuition that I was born as an integral part of a material Universe, in which all life forms appear to have evolved from simple entities. I may experience dreams and other illusions, but I always return to this world, which I believe is the real one. Is it possible to validate this intuition in any way?

According to the foregoing argument, the nature of reality can be verified in special cases by using its own elements. The conditions for this are: a) to prove that the true identity of a thinker is inseparable from its true reality, whenever it happens to exist; b) to prove that true reality has a few exceptional properties, which could not possibly be observed in any other context; and c) to prove that the act of observation of the same properties is perfectly reliable. Thus, any observer should be able to evaluate the reality of its context by looking for clear manifestations of such attributes (*e.g.,* by making a scientific experiment). The outcomes of these observations would produce acceptable answers, regardless of the nature of any intervening contingency. If so, the gap between the thinking self and the absolute foundation need not be explicitly closed, and no external agent needs to be artificially stipulated for this purpose, as long as the specified test is successful. To sum up, I could always know for sure whether my identity and my surroundings are true, if only I had a strong argument to justify the link between my

existence and the outcome of certain special observations. The outline of such an argument is proposed below.

Definitions and preconditions

Seeing the world is not the same as thinking about it, but there is an important similarity. Perception results in mental projections, which are experienced directly, just like thoughts. The world in itself, on the other hand, cannot be experienced directly. Its existence is merely necessitated by the existence of the projections. Therefore, subjective experience is paradoxical. On the one hand, the world has to be primary, in order to make projections in the mind possible. This implies that reflections must be judged according to their level of correspondence to the external reality. On the other hand, projections are the primary (if not the only) element of experience. Objective referents can only be attributed to the images by the intellect. If so, then reality must be judged according to its level of correspondence to some intrinsic property of the perceived images. In other words, it must be something about the images that forces us to assume that the world is real; not the other way around. And yet, the mere existence of rational observers implies that something must exist in an absolute sense, independently from any intellectual effect.

Isaac Newton[29] faced a similar problem, when he was studying the properties of motion. An object could be shifting when it appears stationary; and it could also be still when all evidence points to the contrary. Newton wanted to distinguish true (absolute) motion from apparent (relative) motion in a pertinent way. Relative displacements alone cannot reveal the so-called true component of motion, or even if there is such a

[29] Isaac Newton, *The Principia: mathematical principles of natural philosophy* (Berkeley: UCP, 1999).

component in the first place. However, Newton noted that some types of motion – but not others – produced important physical effects, regardless of their surroundings (*viz*., his bucket experiment[30]). That became his ground for discrimination between true and apparent motion. In light of this example, it is instructive to ask if one could distinguish between true reality and mere appearances on the basis of some kind of verifiable local property. If motion without specific physical effects is not true motion, what could be the essential component of true reality? It was shown by Descartes that rational self-consciousness is a perfectly reliable element of knowledge about reality, when it is experienced in the first person. For the purpose of the current investigation, this finding is a good starting point, because it is logically sound, intuitively appealing, and also practical.[31] Therefore, any external component of reality must be proven to be inseparable from the true self on an observer, if it is to be considered as true as well.

In the interest of clarity, a few definitions are in order. *Consciousness* is defined throughout this investigation as a state of immediate awareness of a junction of mental operations. *Self-consciousness* is to be understood as a state of identification with this junction, specifically as a source of some mental operations, and receptor of others that are produced by independent sources. In this context, *rational self-consciousness* must refer to the ability of an entity to express its self-consciousness in meaningful terms. This expression must be free, or else it is not meaningful. Accordingly, *freedom* is assumed to describe the ability to initiate, interrupt, or otherwise influence the flow of mental activities at will, without any external determination. A statement that is not purposefully

[30] Newtons's bucket experiment investigated the deformation of water surfaces in spinning containers. Notably, the deformation was not directly related to the motion of the water relative to the walls of the bucket. http://en.wikipedia.org/wiki/Bucket_argument .

[31] After all, my certainty about the nature of my surroundings does not have to be stronger than my beliefs about my own existence.

emitted, emerging as a mere epiphenomenon, cannot be intended to mean anything. In other words, freedom is the essential element that distinguishes true self-consciousness from the illusory kind. Therefore, true reality must be established on the basis of its compatibility with freedom.

A well-known difficulty with the concept of freedom is to reconcile it with the concept of determination. An action that is not determined by anything must be random and therefore cannot be an expression of free will. If so, causation cannot be the issue here. The key element must be its source. Throughout the following analysis, it will be understood that an action is free if it is necessarily preceded by a reasoned decision to undertake it, and no other cause, except the same process of reasoning, is sufficient to explain its emergence. It expresses the freedom of the self to act as an independent cause, because it originates inside it and cannot be circumvented by an external process. To be specific, the process of reasoning is used here to refer to the meaning that could be supervenient on a structured mental process, even when the latter has a material manifestation. Therefore, a free decision is to be understood as an act that is not fully reducible to the material process that might sustain it, and cannot be eliminated from the causal chain. This is consistent with the definition from the previous paragraph, which includes the ability to influence the flow of a mental process. Yet, this also implies that freedom cannot be possible in a context, in which consciousness depends on a perfectly deterministic material substratum. Its existence can only be allowed in material universes with imperfect material determinism. Note that deterministic laws can allow for pockets of apparent indeterminism, if they entail complex interactions with random outcomes. Perfect material determinism implies that even stochastic phenomena are reducible to

well-defined physical effects, whether or not exact predictions are possible. Imperfect material determinism implies the opposite: they could be truly determined by randomness or by independent operations that are not reducible to underlying physical forces. It is only the latter kind of material organization that can be compatible with freedom. This limited description is sufficient for the purposes of this argument. A deeper analysis of freedom in connection with determinism will be presented in the next chapter.

It is important to stress that self-consciousness is a necessary a priori condition for any kind of purposeful action. A goal can only be defined in reference to something that can reach it. If the goal is defined by an agent, it presupposes the existence of the agent as well as its relationship to the goal. Therefore, an agent cannot be aware of a goal without being aware of its source, which is itself. On the other hand, self-consciousness depends on the fulfillment of a set of necessary a priori conditions of its own, because it is a complex manifestation of multiple necessary qualities. A complex entity cannot be in place in the absence of any of its necessary qualities. If the qualities, which make it what it is, are not already in place, self-consciousness cannot exist. It could neither produce any of those qualities by design, because that would already presuppose the existence of self-consciousness. Even under the assumptions that self-consciousness *just* exists and has no beginning, all of its components maintain their essential function. Thus, rational self-consciousness depends on the fulfillment of several conditions in any context. Yet, in this discussion, we are only interested in its particular manifestation as an emergent human property. As noted, the problem of reality is primarily important because of the need to test our intuitions about the so-called physical world. Therefore, the main priority

of this study is to identify the markers of rational self-consciousness as a temporally emergent phenomenon.

The main precursors of any process can be identified in a straightforward manner by studying its properties. In the case of a rationally self-consciousness being, the first precondition is the ability to assert its own existence in a meaningful way. Meaning implies by definition a basis for reference and a set of rules for correspondence. Specifically, the notion of self derives its meaning from the opposition to non-self. This distinction may correspond to a true objective opposition, or it may not, but it is still defined via reference to an abstract absolute dichotomy. Axiomatically, the concept of dichotomy is necessarily prior to its exercise. By implication, self-consciousness cannot be expressed without the operation of an analytical principle of deductive exclusion. Analytical rules, which are consistent with meaning attribution in general and deductive exclusion in particular, must have a prior status relative to rational self-consciousness. In practical terms, this means that the rules of deductive analysis have aprioric validity for self-conscious thinkers. Moreover, in a causally emergent Universe, those rules must actually operate before the realization of rational self-consciousness.[32]

The second precondition for rational self-consciousness is the existence of some kind of environment, in which thought is possible. In a deductively comprehensible setting, an entity is necessarily prior to its activity. Consequently, an intellectual context is ontologically prior to the existence of self-consciousness. Something must truly exist such as to contain the elements of a process that could reflect onto itself as mental

[32] This precondition is listed before all others, because it validates the use of logical analysis in this study, and restricts it to the boundaries of the same rules. The intention is to rank the prerequisites as they relate to rational self-consciousness, not as they might relate among each other.

experience. Mental operations must also be amenable to influence, before they can be truly influenced in any way. Moreover, mental operations must be able to develop in a way that enables the emergence of rational self-consciousness. Yet, the context by itself is not sufficient to generate this. Some kind of independent guiding element or agent must be at work in it, if it is ever to acquire awareness of its own activity as such. This agent could be identical with the context; it could also be operating something in it from outside; or it can be a smaller component within it. It may even be that multiple agents are at work. Many possibilities are conceivable, but their exact properties are not relevant at this stage. Regardless of the nature of the agency, it (or the potential for it) has to exist before self-consciousness can happen. Consequently, the true existence of an entity, capable to acquire self-consciousness, is the third a priori condition for the operation of rational self-consciousness.

It is conceivable that mental operations can happen chaotically and in parallel. However, ordered processes require some kind of conditions, in which different types of relationships between concepts can be performed. A meaningful mental statement requires awareness of the fact that one concept is stated before the other. This order may even be crucial for the outcome of the process that involves the concepts. Therefore, structured logical processes cannot be performed without awareness of some kind of temporal context. Moreover, in addition to the temporal rearrangement of concepts, it must be possible to have awareness of the ways in which they can be related by virtue of their properties. Whether concepts can be related to each other (or not) depends on the existence of some sort of context, in which such relationships can occur. Consequently, there can be no notion of relationship between different categories without a proper

awareness of spatial context for such operations. Ordered statements are impossible without awareness of the fact that order is possible. As a corollary, the fourth precondition for rational self-consciousness is a state of awareness of spatial and temporal organization of mental concepts.

Mental operations are by definition dynamic. Awareness of activity implies awareness of the fact that something is not finished. Something is happening in the present, as it flows from the past into the future. In this context, awareness of self implies awareness of the activity of the self. This implies awareness of the fact that past activity was also related to the same self. Consequently, self-awareness must be impossible without the means to track the connection between the self and its mental activity. Self-consciousness must transcend the boundaries of its own transient operations, which cannot happen without a way to record and recall passing activities in their order. It is even doubtful that meaning can be attributed to anything without the ability to recollect. Consequently, memory is the sixth a priori condition in this list.

Awareness of the attributes of self implies an analytical dissociation from them, such as to enable the definition of these dependent concepts. These distinctions – between self and dependent processes, between self and independent processes, as well as between dependent and independent processes – demand the existence of a structure, which makes them coherent and appropriate. The first precondition noted above ensures that self-conscious thought is sensitive to contradictions. Hence, self-awareness cannot be in flagrant contradiction with the totality of experiences that contain it. The concepts of "self" and "non-self" are inseparable because they have co-determinant meanings. Ontologically, this means that self-consciousness cannot emerge in the absence of

sensorial grounds for distinction between self and non-self. Consequently, a system of observable independent processes must exist, as well as a system of means of interaction with it, before the actual emergence of self-conscious activity. This is the seventh precondition for rational self-consciousness.

Existential realms[33]

The foregoing list of a priori conditions for rational self-consciousness is not intended to be exhaustive. It is, however, sufficient to point out the insurmountable gap between the identity of a thinking subject and its own true essence. The subject cannot have a superior alternative to the rules of deductive analysis, nor can it have immediate access to a more perfect reality than whichever happens to be available at any time. It cannot doubt the content of its memories and its perceptions, any more than it can doubt its own existence, because they produce its existence, as such. All of these elements must necessarily feel self-evident to the subject, in the same way in which its own existence is necessarily perceived as self-evident. As shown above, self-consciousness can only emerge when all of these preconditions are met. In short, a self-conscious subject is ontologically subordinate to an existential realm which defines its existence. If the subject interacts with other subjects in its own realm, the existence of such subjects is unquestionable. Material objects and processes that appear to affect the subject are equally valid as real elements of existence. Consequently, the contents of an existential realm are necessarily objective for a self-conscious observer.

[33] The word "existential" is used with a special meaning in this context. An existential realm is a coherent phenomenal Universe (or "dreamworld"), which is associated with a feeling of existence in it. It could also be called an "experiential" realm, since it circumscribes the totality of possible expeirences that are available to an agent in such a context. No relationship with the philosophy of existentialism is intended.

This conclusion brings us back to the paradox of experience, described at the beginning of this argument. The existence of an observer requires the existence of a true essence, which is not dependent on any appearance. Yet, the rationalized self does not enjoy this status and is necessarily subordinated to the surrounding appearances. The latter come first, and the self can only be defined on the basis of their content. To assume that they are not real is to be in self-contradiction. The experience of opposition between self and non-self, which defines self-consciousness, is limited to the mental realm in which both self and non-self emerge as projections. Thus, rational self-consciousness is structured around a mental process. The objectivity of the subject and the objectivity of the elements that co-exist with it are dictated by the parameters of that mental context.

As a consequence of the above, the identity of a self-conscious subject is at the mercy of contingencies that govern its emergence and activity. If the content of its memories were to be somehow corrupted or modified, it would acquire a distorted idea of itself, compared to an earlier state. Similar corruption may affect any of its mental faculties or perceptive organs. The world must always appear real as it is to the observer. The affirmation of the self must always happen in the present. Therefore, it is the present content of memories, perceptions and operations that define the self-affirmation of the subject. This means that the subject can experience multiple mental realms with different rules of consistency at different times. Every realm can feel real in the present tense, when it is being experienced, creating the impression that other remembered realms are less real, perhaps even dreams or hallucinations. The subject is always ontologically subordinated to the reality of its present realm, regardless of its nature. In other words, a self-conscious subject can experience multiple existential realms without any immediate

standard for discrimination among them. By implication, the status of the observer does not eliminate radical skepticism. It makes it rather unavoidable, because the observer is unable to distinguish among various types of reality on the basis of experience.

The previous conclusion can be clarified in a straightforward manner with the brain-in-a-vat example. A person, whose reality is projected by an advanced computer, must necessarily develop its concept of self on the basis of those projections. The brain is assumed to belong to an absolute reality, which could produce a proper observer in a body belonging to that reality. However, the thinking observer from the vat defines its identity on the basis of virtual projections and is inseparable from them. It cannot make a meaningful statement about its own likelihood of being a brain in a vat, without being in self-contradiction. The "I" is an integral part of the image and cannot exist outside of it. On the other hand, the subject is able to understand and express its subordinated status without self-contradiction. Therefore, it has no choice but to start from radical skepticism, in order to see if a method for relevant discrimination among different existential realms is possible. This conclusion is different from other philosophical arguments on this topic, and requires additional explanation.

A relevant example is Hilary Putnam's argument about the semantic limitations of rational subjects in envatted brains[34]. He showed that such thinkers would not be able to make meaningful statements about their true condition. Specifically, the statement "I am a brain in a vat" can not mean what it is supposed to mean, if in fact the subject is sustained by a brain in a vat. It must also be false, if in fact the subject is not in that condition. Putnam claims that such a statement should be treated as self-refuting, in the

[34] Hilary Putnam, "Brains in a Vat" in *Reason, Truth, and History* (New York: Cambridge, 1981), pp. 1-21.

same way in which the statement "I do not exist" is self-refuting. However, this latter statement has a very clear meaning. It is precisely the correct meaning that renders the statement self-refuting, whenever it is properly stated. In contrast, Putnam's semantic argument implies the absence of such meaning. Thus, it is the ability to formulate the required meaning that is refuted. The proper conclusion, as shown in the foregoing paragraphs, should be that a thinking subject can only assume that its context is real, regardless of the source of external projections. Rather than saying: "Therefore, I am not a brain in a vat", the subject can only say "Therefore I can not even think that this world (or any other world I might experience) is not real". This does not refute radical skepticism. Instead, it explains one aspect of the mechanism that makes it inevitable.

To be exact, radical skepticism is no longer the best concept for this context. Skepticism implies a degree of uncertainty about one state of things or another ("For all I know, I could be a brain in a vat"). Yet, the foregoing argument has a stronger implication: "I am certainly and at all times equivalent to a brain in a vat". The proper distinction between real and illusory is no longer constrained by a limitation of means. The concept of reality, as opposed to non-reality, is entirely inappropriate for a rationally self-conscious being. In the ontological hierarchy of existence, absolute things (first-order reality) produce projections (second-order reality), which produce conceptualized self-awareness (third-order reality). The status of the observer is such that it is always enclosed in a second-order existential realm. This new approach may seem to increase the anxiety about the essence of the world, but only on the surface. The distinction between real and illusory is no longer consequential simply by itself. Traditional radical skepticism implies that the self is somehow absolute, in a way that does not depend on its

surroundings. An illusory world could prevent the subject from realizing its pre-established purpose (functional or moral), or even prevent the true exercise of freedom. In contrast, the subordination of rationally self-conscious entities to their present existential realms removes this possibility. The absolute self is replaced by the self as known to itself. Absolute objectivity is replaced by contextual objectivity. Moral responsibility or purpose can only be defined in terms of things that can be experienced. Thus, instead of the anxiety about a true reality that *must be* experienced, the real concern becomes the proper understanding of the existential realms that *are* experienced. This is not meant to suggest that first order reality does not exist. It is still there, and quite important (as will be shown below). Nevertheless, its actual particularities cannot be relevant for the decisions of a rationally self-conscious being.

From the perspective of this redefined approach to skepticism, contextually true and contextually illusory reality cannot be distinguished on the basis of direct experience. However, a meaningful rational evaluation must be possible, because self-identification is by definition a semantic operation. By virtue of the first a priori condition for rational self-consciousness, a set of rules must be in place to make the notion “I” meaningful. “I” is a true notion when it follows properly from its rules and when it corresponds to a specific contextual state of fact. If appearances are consistent with the rules and properties that can produce a true notion of self, they must also be treated as true. What makes one true, applies to the other as well. Conversely, when appearances are not fundamentally coherent in the same way, they cannot be consequential to the same degree. True contexts are necessitated by the mere existence of a subject, and inconsistent existential realms should be treated as super-impositions on them. The proper status to be

attributed to incoherent contexts is that of illusions. As a corollary, the problem of skepticism can be reduced to the problem of identifying internal (and therefore observable) properties of existential contexts, which can serve as indicators of true reality. The important distinction is that true reality cannot be described as absolute reality, because it belongs to the level of second-order reality, just like the illusions.

Absolute reality

The processes that facilitate the emergence of an existential realm depend on the existence of external sources for it. If there are operations, there must be something that performs operations. If there are projections, there must be something that projects them. Thus, the hard context of mental operations and the source of objects of perception must exist in one way or another outside of the mental context of the self-conscious subject. Still, the a priori existence of such external entities can only be inferred. They can never be directly experienced. Relative to the self-conscious subject they represent a meta-realm, which generates all the existential realms. It is remarkable that the fundamental sense of self must transcend all existential realms, as long as they are experienced by the same subject. This demands the existence of a single coherent meta-realm, in which the sense of self is maintained in its continuity, despite the multiplicity of existential environments. The meta-realm is the absolute reality, which was defined above as first-order reality. The problem is how to describe it. Is it a realm of things in themselves, or a realm of forms? Is it somehow “objective” in a way that is opposed to the “subjective” experiences? No particular description emerges as self-evident, except that it must be a transcendental realm, which makes second-order (and third-order) reality possible. The

same multiplicity of experienced second-order realms seems to suggest that the meta-realm is somewhat like hardware for software in a computer.[35] The important difference is that the meta-realm must contain rationally self-conscious entities. This property must be explored in full, in order to see if it constrains the description of first-order reality.

The existence of a temporal order is *a priori* for the self-conscious subject, as shown above. This means that it had to originate only once in a specific existential realm, emerging in all other realms as already existing. The rules of the original existential realm must be consistent with the rules of the meta-realm in a way that makes possible the constitution and development of self-consciousness. Subsequent realms do not have this constraint. Furthermore, the emergence of self-consciousness is a qualitative effect in the original realm, which must correspond to a qualitative effect in the meta-realm. The emergence of the same subject in all other realms can produce only a quantitative effect in the meta-realm. Thus, the original realm has a set of mandatory properties that set it apart from all other possible existential realms. In the language of the brain-in-a-vat scenario, the brain must obey the laws of the external Universe, whereas the personality lives by the rules of projected images. If the concepts of thought are supported by the functions of the brain, the two systems of laws must be coherent, in order to makes it possible for the brain to relate projected images to other mental elements that are dictated by its own properties. Without such coherence, rational self-consciousness cannot emerge. Though, once established, it can experience realms of various levels of consistency. Only the initial context, in which the observer acquires self-consciousness, has the requirement of correspondence with the principles, if not the facts, of the first-

[35] Objects and characters in videogames, for example, do not correspond to components in the hardware that projects them.

order reality. Consequently, the existential realms can be compared to each other on the basis of their propensity to reproduce the qualities of the ideal-type original realm.

A variety of contexts can be conceived such as to lead to the emergence of self-consciousness. Still, we are only interested in those in which beings appear to form and acquire self-consciousness through growth. In other words, the focus is on the following question: what should an existential realm be like, in order to enable the emergence of rational self-consciousness on its own? Consider an agent that is developing in such a context. There can be no purposeful activity on behalf of the agent that is about to acquire self-consciousness,[36] but the context must be such as to make it possible. The nature of the primary existential realm must be such as to enable the agent to make the realization of its own activity. Before an agent can realize that it can be a source of events, it must be able to achieve awareness that events can lead to other events in general. Moreover, certain events must always have the same consequences, in order to justify the generalization that some processes cause other processes.[37] The observable laws of organization of the realm must be infallible. The agent must be able, in principle, to always distinguish between actions that are produced by it and those which are not. Furthermore, the entities of the original mental realm must be well-defined, such as to enable the proper distinction between self and non-self. In the absence of such properties, the emergence of self-consciousness as a coherent part of its context is impossible. As a corollary, rational self-consciousness cannot emerge on its own, except in a second-order realm with well defined entities and unfailing causal laws to govern their interaction.

[36] Purpose can only follow self-consciousness.
[37] A prerequisite for the concept that the agent can cause some outcomes.

The previous conclusion can be refined even further. The constant properties of a realm imply that its constituent entities cannot change arbitrarily. Objects cannot emerge out of nothing, or vanish without a trace. If they undergo transformations, this should be understandable in terms of already existing parts. As shown, any and all constituent parts should be well-defined. This means that all objects should consist of perfectly discrete constituent parts, whenever they have any. Furthermore, any change in the appearance or distribution of the objects of a realm should be intelligible in terms of causal interactions between or within them. These causal processes should work without exception, such that the outcome of any process can be reasonably predicted, given perfect knowledge. Finally, the causal laws must be structured in a way that is compatible with deductive analysis, or else the subject cannot achieve full understanding of its context (not even in principle). The subject may or may not be able to process enough information for a perfect decision every time, but the realm should not be governed by principles that prevent exhaustive understanding. The laws of a realm might impose constraints on the type of freedom that is possible, but it should not be biased against its exercise. To sum up, the original existential realm of a subject should appear to have a constant amount of substance. It should also consist of discrete entities, whose components, if any, are also discrete. The behavior of these entities should be well-defined, according to unfailing and intelligible causal laws.[38]

It was shown above that rational self-consciousness must emerge as a qualitative change within an ongoing mental process. Moreover, this change requires the operation

[38] As a reminder, the original realm, also called primary realm, is still an existential context that belongs to second-order reality (i.e., appearances/projections) in the ontological hierarchy. It is primary for the subject, because it enables the emergence of third-order reality (self-awareness). In the same context, absolute reality is described as the meta-realm.

of deductive principles of reasoning. Yet, self-consciousness is a precondition for purposeful mental activity. Can the principles of deductive reasoning operate without being purposefully formulated? Even if self-consciousness does not have to be perfectly articulated in words in order to emerge, the governing deductive principles must be clearly at work. Thus, either rational self-consciousness cannot emerge independently, or deductive reasoning can emerge without purposeful formulation. The first option cannot be considered here, because the goal is to find the observable properties of contexts for independent emergence of self-consciousness. If so, the emergence of deductive reasoning must have an explanation that cannot be grounded in the agent. It must be a necessary property of the mental process that existed prior to the emergence of rational self-consciousness. The mental context is a product of the processor, which exists in the meta-realm. The only reason for the mental realm to be intelligible in deductive terms and for the agent to have an immediate affinity for deductive analysis is to be found in the rules of operation of the processor. This means that the rules of the meta-realm, which govern the operation of the processor, must be such as to makes this inevitable. For this to be true, every material property in the meta-realm must have a corresponding mental equivalent, so that in complex arrangements mental processes could be a direct reflection of material interactions. Furthermore, these interactions must be structured such as to be immediately represented on a mental plane by logical categories that are compatible with deductive processes. First-order reality (incorporating a functioning brain) can translate into third-order reality (self-identity), without intervening external agents, but only if the intermediate second-order (projected) reality shares the same principles of operation. In other words, the governing principles of the original existential realm, described in the

previous paragraph, must also apply to the meta-realm. It must contain discrete entities governed by well-defined and unfailing causal laws, which would necessarily induce supervenient processes that manifest as deductive logical operations. In the absence of such properties, the first a priori condition for rational self-consciousness cannot be fulfilled. Consequently, a self-conscious subject cannot emerge on its own, except in a meta-realm with well defined entities and unfailing causal laws for their interaction. The original existential realm must reflect the principles that govern the meta-realm. This means that first-order reality can be treated conventionally as a realm of things-in-themselves for the original existential realm of a rationally self-conscious entity.

The argument from the previous paragraph has produced a solution to one problem, only to create another. On the one hand, first-order reality should be compatible with a description in terms of unfailing material causality, in order to enable the emergence of rational self-consciousness. On the other hand, it was also shown above that rational self-consciousness cannot be true and meaningful without freedom from material causality. None of the two is sufficient to produce rational self-consciousness on its own. Yet, freedom and determinism are incompatible categories. This is not exactly a conundrum, because it is not a matter of alternative possibilities. Both of these (apparently incompatible) properties must be reconciled, or else rational self-consciousness is impossible. It is the goal of the next chapter to derive a solution for this problem. As will be revealed, a material meta-realm must posses a set of unique properties, if it is to satisfy the requirements of the presented argument. In the final analysis, this will provide the grounds for a method to identify true existential realms via empirical observation.

Summary and conclusions

At the beginning of this essay, it was shown that observable reality can be validated in terms of its own components, provided three conditions are met. Firstly, the true identity of the observer must be demonstrably inseparable from the existence of a true context of observation. Secondly, some properties of true reality must be exclusive to it, in order to establish the link between their observation and the nature of the context. Finally, the act of observation of the same properties must be shown to be reliable, at least in principle. Two of these prerequisites – the first and the third – were fulfilled in full, while the second one was resolved just partly. Though, it is the task of the following chapter to complete the argument. These prerequisites were fulfilled by showing that observable true reality can never be treated as absolute reality. Observations add up to a realm of their own, whose actual link to absolute reality is entirely unknown. On the other hand, the same observations, unreliable as they are, provide the basis for the development of self-consciousness. In contrast to radical skepticism, where subordination to a virtual realm is a possibility, this principle declares the same subordination with certainty. Paradoxically, this negation (of the possibility to experience true absolute reality) provides the means for identifying the true second-order reality, which can be treated as a necessary reflection of first-order reality.

A rationally self-conscious being can experience multiple existential realms, but only one realm is consistent with the actual emergence of subjectivity. In this realm, first-order elements (such as the mental processor) must be coherent in a deductively intelligible way with all elements of second-order elements (perceptions), as well as with the identity of the subject. Moreover, the first-order source of mental processes and its

second-order representation must be in perfect agreement. If the perceived body is operating in a manner that is independent from its absolute equivalent, a contradiction between the internal state and the perceived external state is inevitable. Thus, many second-order realms can feel natural for limited periods of time, until the first contradiction comes to the surface. The original realm cannot produce such contradictions, because it can only produce the manifestation of rational self-consciousness if it is free of such issues. When a subject is experiencing the same realm for extended periods of time without any detectable contradiction, the only remaining problem is to determine if this realm is compatible with its true essence. In other words, it must operate according to material laws that are compatible with the evolution of rational self-consciousness. This can be verified by testing the properties of matter. If the experiments confirm beyond doubt the required properties, to be spelled out in full in the next chapter, then the observed realm qualifies as authentic. Even after such confirmation, there is no final certainty that the experienced realm is the actual realm of emergence of the subject. However, this is not consequential, because rational self-consciousness belongs to third-order reality. It has no absolute equivalent in first-order reality, and its proper (*i.e.* free) operation is the only real concern. A perfectly coherent realm represents true reality because it is consistent with the true identity of the self-conscious subject and is compatible with its exercise of freedom.

As a corollary, when the subject happens to experience true reality, its true identity is inseparable from the context of observations, its observations are reliable, and the observation of the specified indicators can only be attributed to true reality. When illusory realms are being experienced, the observations are either sufficient to confirm

this by virtue of their inconsistency, or they are indeterminate. The important conclusion is that spurious validation of reality is not possible in any way that is philosophically consequential. As a corollary, true reality can be verified on the basis of contextual observations alone, at least in some cases.

III. THE PROBLEM OF FREE WILL

Abstract: This chapter demonstrates that free action can be based on informational grounds that are neither arbitrary, nor predetermined. Such a solution is possible by allowing for a process of learning through unconstrained choices among predetermined options, within a pre-existent teleological framework. Free action is determined by well defined considerations, but the content of the latter is not directly determined by the context, and the trigger for action is based on a metaphysical element. This type of freedom depends on the existence of a material context with unfailing deterministic laws that are also compatible with metaphysical influences on final outcomes. Such a context must possess a set of unique properties, and this is what makes the hypothesis of free will verifiable from inside the existential realm of a rationally self-conscious being.

Causality without determinism

The problem of true agency has been investigated and debated many times over. Yet, the concepts involved are very well-defined and their implications seem to be clear: one cannot reconcile the folk definition of free will with the existing definitions of determinism and randomness. The problem is essentially logical: regardless of the mechanism of causation (mental, physical, or some other alternative), voluntarism cannot emerge within a process without losing its original purpose. It lacks a fulcrum that is well-defined and free at the same time. Such a conclusion is hard to accept, because it simply does not feel right. The notion of free will has a strong intuitive appeal, just like the notions of determinism and randomness. It is paradoxical that they should be so hard

to reconcile. Could it be that these concepts are flawed? Or, maybe, this is not really a conceptual problem? The arguments about free will are usually formulated at an abstract level. As defined, they are clear and well understood. One has to wonder, though: what if these arguments are sound, without being valid? What if free will is impossible at some level of abstraction, but still possible in specific contexts? It does seem striking that most philosophical arguments employ idealized versions of the mental systems, without factoring in the limitations of human beings and/or the dynamics of their development. If the mind is assumed to be a perfect intellectual machine, with perfect knowledge about all possible outcomes, then choices must be produced in a semi-mechanical fashion, according to clear criteria for decision-making. If, on the other hand, one assumes that most choices are performed in the absence of sufficient information, and other factors influence the process of decision-making, then the mechanical parallelism could fail in isolated contexts. Therefore, the distinction between determined and random elements of mechanical processes might not be sufficient to describe all the elements of human decision making.

Determinism and randomness do not exhaust the entire list of possible types of action, even in a classical model of causality. As a reminder, the classical systems of causality imply that every effect has a cause. Moreover, determinism implies the operation of the arrow of time, which dictates that all causes should come earlier than their effects. Whether we are dealing with a mental operation, or a material one, we expect a well-defined sequence of events. So, determinism can fail for two reasons: it can be mixed with elements of randomness, or it can suffer violations of the arrow of time. A cause from the future would not be reducible to an earlier state of events. The process is

still causal, but determinism fails. This type of process is known to raise more problems than it solves for mechanical systems, but it also has a softer version. When a part of a system is treated in isolation, its analysis is insufficient to predict subsequent outcomes. At this level of analysis, future interventions from external causes can be treated as causes from the future, without producing unnecessary paradoxes. Similarly, mental operations can be influenced by unknown external factors, prompting partial resolutions for action. For example, a subject could have a well-defined goal and insufficient information for a final decision. The compromise is to make a conditional decision, with the intention to make future corrections as more information becomes available. This is equivalent to saying: “Let the future decide”. Strictly speaking, this is not a violation of determinism, but it does illustrate the possibility of an action being anchored in considerations about the future.

Another important aspect of the interplay between determinism and randomness is their manifestation in complex arrangements, particularly those involving trial and error. Some complex operations can depend on sequences of random steps without producing random outcomes, depending on their principles of organization. Consider the following two cases:

1. There are two counters in a room. One counter has a basket filled with black and white balls. The other counter has two empty baskets, labeled “Black” and “White”. The task is to sort the balls into the appropriate basket, as labeled. I inspect every ball visually and sort them by color.

> 2. There are two counters in a dark room. I know that on the counter on my left there is a basket filled with black and white balls, and the only way to tell them by color is to expose them to light. I also know that on my right there is a counter with two empty baskets. The basket on the right is for black balls. The basket on the left is for white balls. I have to sort them out, but there is a problem. Whenever balls of opposite color are exposed to light, they explode. In order to complete the sorting procedure safely, I must take one ball at a time out of the room, observe the color, then take it back into the dark room and place it in the appropriate basket.

There is an obvious difference between the two situations: the sorting procedure is more complex in the second case. Nevertheless, the end result is not different in any obvious way. As long as the criterion is to have the balls accurately sorted, it is satisfied. My observational ability determines which ball ends in which basket. In the ideal case with zero probability of mistake, the outcome is perfectly reliable and I can take a full basket of white or black balls out into the light, without any fear of explosion.

There is another important difference between the two cases. In the second example every ball (except the last one) is picked out of the basked at random. Is this of any consequence for the final result? It is hard to see why this would be the case. The procedure is exhaustive and stipulates the inspection of all objects. The order of selection has no effect on the sorting procedure, which is based on color alone. In fact, it could be argued that some element of randomness is present in the first case as well, because I do not have any criterion for choosing specific balls. If I were to try to pick only the white

balls, I would see them all, but my order of picking individual balls one by one is largely indeterminate (assuming the balls are physically indistinguishable). One could argue that in reality the choices are not necessarily random. Still, the final outcome would be the same if they were.

In conclusion, internal randomness is relevant only if it translates into external random outcomes. In an exhaustive sorting procedure, the nature of intermediate steps does not carry onto the final result. The task is defined at the level of the whole finite set, and the sorting operation is deterministic. Ergo, it is possible for some types of processes to include fundamentally random steps, without being random at the aggregate level. Each step of the sorting procedure is meaningful, because it is informed by the rules and principles of the process. Moreover, the exact content of the sorting baskets is undetermined until the final stage, without being arbitrary.

As a corollary of the above, causal operations can be meaningful and self-consistent even if they contain considerations about the future (in the case of partial and/or conditional decisions) or elements of randomness. This means that it might be possible to develop a complex precursor mechanism for free decision making by using such elements in a causal chain. As a reminder, the problem of free will is to anchor a decision in considerations that are neither random, nor predetermined. Moreover, predetermination does not rule out all prior conditions. It is sufficient to show that there is at least one instant in time, prior to the existence of the agent, when the state of the Universe cannot be sufficient to determine the outcomes of its decisions. Thus, an agent could have a meaningful basis for free decision making, as long as this basis is developed without full conformity to determinism. For example, a moral decision could be based on

a set of moral considerations. If the latter were acquired through a sequence of random conditional choices, and subsequent sorting on the basis of experience, the moral ground might not be reducible to a prior state of the existential environment, if the agent started from a state of complete ignorance. A decision that is determined by a well-defined set of considerations must be categorized as meaningful. Moreover, if this foundation for agency is internal to the thinker and its content cannot be determined directly by external processes, then it is possible for a decision to be meaningful and free. Ergo, free will can be compatible with existing intuitive definitions of determinism and randomness, without being itself counterintuitive. This is not a claim that free will is guaranteed *a priori* in any context. It is however sufficient for it to be contingently possible, in order for the concept of freedom to be meaningful.

Grounds for action

Free will is a complex phenomenon, insofar as it has an emotional element – the drive to initiate an action – as well as a rational content that informs its meaning and relevance. Yet, our current understanding is that emotions obey deterministic rules, acting as mediators between stimuli and responses. Moreover, rational operations also appear intuitively as deterministic, at least in principle, because conclusions must follow with necessity from premises regardless of contextual considerations. In light of this, it seems that the ability to exercise free will should have an independent substratum. In the same way in which emotions and reasons unfold in parallel in the mind of a single subject, there must be a separate function that acts as an arbiter in cases of conflicting instructions for action. Emotional drives could be in conflict among themselves, just like the rational

prescriptions for action, or the two types of motives could contradict each other. It seems natural to invoke a special mental operation that solves contradictions in the decision-making process. Though, such an operation would have to be grounded on independent mental elements, including memories and arguments, in order to act in a free way.

The foundation for free decision making could be described as an accumulation of random elements, filtered by some principle of consistency. This would be sufficient for meaningful instructions for action that are not predetermined. Still, this would violate the folk definition of free will. A free action would be unsatisfactory from a moral point of view, if it was grounded on arbitrary founding principles. Our intuition about morality is that it is worth having for some superior reason, however poorly understood. In order to accommodate this concern, it is preferable to assume the existence of some sort of innate universal moral sense, which is too abstract to express but specific enough to identify. For example, we could describe the subject as having the capacity to recognize the difference between right and wrong when it is experienced, prior to any capacity to anticipate its features. This ability could serve as a guiding principle for action even if the subject were ignorant about the means to exercise it. Accordingly, ignorance about the means to achieve some moral goal could inform a process of trial and error, during which the subject learns to attribute types of actions to various moral tags. Every learning step would involve random choices, informed by non-random motivations to sort all types of actions into moral categories. Eventually, a memory bank of such choices and their outcomes would be able to serve as ground for mature decisions of a moral nature. Insofar as the initial decisions are purely random, they cannot be produced by earlier causes. The resulting moral tags could also be dependent on contextual factors, meaning

that similar actions could end up with different moral tags in different contexts. As a corollary, the state of moral maturity could be well-defined, providing a meaningful basis for subsequent action; it would also be acquired through meaningful steps, informed by innate (and even shared) guiding elements; though, it would not be predetermined, because each step would be fundamentally arbitrary and irreducible to prior states of the environment by design.

The foregoing description has shown that moral decisions can be free, at least in principle, because they can be meaningful and non-arbitrary, even if the moral foundation is acquired through contextually random steps. The subordination of this process to overall guiding principles and considerations about the future overrides the concern about overall arbitrariness of the foundation. Random learning decisions have been described above as conditional decisions, belonging to sorting models that are based on the principle of trial and error. A possible vulnerability is the charge that a context can determine the content of the moral foundation, voiding the impact of randomness at each step. For example, all members of the same society are likely to have the same moral reasons, as a result of the types of practices that are being enforced consistently. This possibility is not necessarily a weakness of the model, because a society can start from an original state of no moral knowledge. As the society develops, it can settle on a system of practices with moral connotations, but the building blocks must all be dictated by local accidents of interaction that may not be predetermined by the material laws of any given context. It is conceivable that some practices become the norm simply because they were attempted prior to other alternatives. Hence, different societies can end up with different moral systems, or the same society can change its moral values in time. The requirement

of this argument is only to show that it is possible to describe self-consistent Universes, in which the evolutionary paths of moral systems are not necessarily predetermined. Note that the details of moral considerations for action would be entirely predetermined, if a person relied on them only upon reaching exhausting knowledge about the Universe, with a perfect record of the most likely outcomes of all the possible choices. However, such an ideal state is unrealistic in real life. A subject with a human lifespan is more than likely to use partial knowledge with accidental elements as grounds for decision making. It is these imperfect levels of knowledge that are unpredictable, even when randomness is perfectly contextual and inconsequential at the end of exhaustive processes.

The previous conclusion notwithstanding, it is instructive to ask: what if a subject was placed in a Universe with simple situations, which could be understood exhaustively in a small portion of a lifetime? As argued above, the sorting procedure with overarching principles must neutralize the effect of its arbitrary events. Once perfect knowledge is acquired, it is as if the subject was born with clear instructions for action, or at least with clear moral prescriptions for every situation. Can we claim that free will is impossible in such a context, just because the content of grounding considerations is predetermined? Such a conclusion is highly counterintuitive. After all, the folk definition of free will is about the freedom to ignore moral prescriptions, even if they were preordained. For example, theological discussions frequently make reference to the freedom of humans to defy divine rules. Thus, independent moral knowledge cannot provide sufficient grounds for free action. The definition of the ground for free action must be relaxed to include other concerns. In this particular case, it seems appropriate to stipulate the operations of a sense of identity of the subject relative to all possible grounds for action, as a sufficient

foundation for free will. Just as before, this sense of self could be developed in a manner that is not predetermined. Hence, the subject could reach independent foundations for action by starting from a state of ignorance about itself, and going through a sequence of formative choices, which are essentially random, but informed by the intention to learn form the outcomes. Every choice is followed by context-determined experiences that influence non-commutatively the sense of self of the subject. Even if the agent goes through all types of action of a finite list of possibilities, the order of those attempts can translate into different types of experiences and effects on the subject, producing different final identities. If the order of the formative choices is random, the final sense of self of the subject cannot be predetermined. The caveat is that a subject's identity must not change significantly once formed. This requirement is not necessarily appropriate, for it seems reasonable to expect that a subject should maintain the flexibility to learn from its environment continuously, at least in some Universes. In this case, the accidental effects of early learning could be undone given enough time, and then a predictable final state of perfect understanding of the self would follow. On closer inspection, this implication is preferable for the presented model, for it provides protection against charges of illusory freedom. The drive to learn and the possibility to achieve perfect knowledge provide the framework for the so-called sorting procedure described above. Without such a framework, all conclusions would be arbitrary, and the final effect would be arbitrary, negating the claim that randomness is subordinated to a meaningful superstructure. As a corollary, even this wider basis for knowledge, including the sense of self of the subject, has a limited validity for the exercise of agency. It only works for beings with imperfect knowledge about themselves and about the world. This is an acceptable compromise,

because it is good enough for the situation of human beings, which are known to have limited life-span and complex existential environments.

Having gotten this far, it is time to put the model to the test. Let us assume that a robot is programmed to start learning when confronted with new situations. It has clear instructions what to look for and how to filter the results of all learning steps. The mechanism for learning could be designed to mimic exactly the model presented above, and the robot could indeed develop a state of well defined knowledge for future non-random action, manifesting the temporary individuality that is conferred by the nature of its limited experiences. Does the robot have free will? It will definitely have its own personality, compared to any number of identically created robots that are sent into the same world. Nevertheless, the robot is by definition a machine that reacts to external stimuli. Its operation is fully determined by the electrical processes that run through its processor. Hence, the robot can only react to external situations, or express pre-programmed sequences of activity. It can never initiate a course of events of its own volition, simply because “it felt like it”. On final analysis, the robot is a very sophisticated entity, but it cannot be more than an automaton. Even if it possessed some sort of subjectivity, it could only be epiphenomenal. This goes against the expectation that the agent should be the ultimate cause of its actions. Free will is potentially arbitrary in any context, being either totally uncaused, or irreducible to the external processes that induce its exercise. This means that the power to be an agent must have a metaphysical source in any physical context. Any other way to produce it must fall short of the requirement of perfect independence. Still, such a power must also be grounded in its context in order to be relevant. Therefore, it seems appropriate to postulate that the power

of free action should be subordinated to the power of an agent to be self-conscious. If an agent had limited knowledge, its free will would be undefined and fundamentally random. If the agent reached some level of maturity, it would also acquire a foundation for meaningful and well-defined free action, in accordance with the model presented above. In other words, the "sorting procedure" is not so much a model of free will, as it is a model for producing informational grounds for its meaningful exercise. Accordingly, a robot could ascend to the level of a rational free being only if it had the power to exercise a non-physical influence over the (otherwise) random physical process that enable formative decisions at the developmental stage. Moreover, the exercise of this power should be informed by the content of its independently gained experience.

To sum up, free will can manifest itself as a meaningful process, but only in special material contexts with special rational beings operating in it. The context must contain purely deterministic, as well as purely random processes, and must even allow for some sort of mysterious non-physical influence over the outcome of undetermined processes. In other words, random processes should be amenable to description as if determined by probabilistic laws in some cases, and also as if determined by telepathic directives (from the mind to its own body) in other cases. Furthermore, the minds of rational beings must contain: (a) deterministic emotional and analytical processes; (b) a non-deterministic mechanism for sorting out conflicts between various motivations for action; and also (c) a metaphysical will to act that can influence the sorting mechanism. The decision to choose any single alternative must be independent from the original reasons for action. When fully defined, it must be based on a set of post-factual memories of conclusions obtained via trial and error during developmental stages of the agent. This

is an odd set of necessary properties, and it raises two important concerns. Firstly, it is not immediately clear that all of these demands can be met without contradiction in a single environment. Secondly, if the first concern is overcome, it is no less important to know if such an environment has any common property with the Universe in which human beings exist.

Universe for the free

It is difficult to speculate how many types of material contexts are compatible with the model presented above, if any. Though, it is not essential to get an exhaustive description of all of them. As indicated by the second concern, only a limited class of environments is relevant for this discussion. Hence, it seems efficient to begin by narrowing down the list of possible solutions by adding more restrictions, in order to arrive at the most highly preferable description of the necessary environment for free action. This statement is informed by the consideration that freedom must be not only possible, but also useful. For example, decisions may frequently be motivated by goals about the outside world. If the world were to be governed by unintelligible rules with unpredictable outcomes, it would be impossible to make any reliable assessments of future states. In this case, it would also be impossible to achieve the intended outcomes from actions aimed at the external world. Moreover, it would be quite preferable to live in a world that is entirely predictable, at least in principle, just as the classical concept of physical determinism implies. The problem, of course, is that such a world does not allow for the emergence of free will. The second best thing would be to have a world in which there is only one exception to this rigid determinism – the person who intends to act. Yet,

this requires a singular arbitrary exception for the existence of free will, which creates too much room for the possibility of other arbitrary exceptions. That is why it is preferable to inhabit a physical world with unfailing physical laws, even if they are insufficient to determine the totality of all possible events. Moreover, it is just as preferable to postulate that any island of physical activity, which is exempt from the effect of deterministic laws, should only be possible in very specific configurations of material organization. The emergence of these islands should also be somehow determined by the mentioned unfailing laws. This condition would ensure that every event in the external world is either predictable, or produced by independent causes in predictable regions of space and time. Preferably, these exceptional events with independent causes should be very rare. Such a context cannot be described as deterministic, although every event is stipulated to have a cause. In fact, there are several types of causality: deterministic material, probabilistic material, deterministic mental, as well as probabilistic mental. Still, material determinism is awarded a special status, insofar as all other types of causes are only allowed to operate without contradicting it. This type of causality shall be called “open determinism” from here on. It applies to Universes in which material determinism is never contradicted, without being sufficient to determine all physical events.

As emphasized above, useful freedom requires an intelligible context with unfailing physical laws. Still, what does it mean to have an intelligible context? One could argue that quantum mechanics and special relativity are intelligible, even if it may be challenging to visualize their details. In order to solve this problem, the highest standard shall be defined here as the one that only allows for models which are easy to perceive intuitively. This should simplify the following work, because very few models

could satisfy it. If no model shall be found to fit the bill, the same steps can be repeated with a more generous standard. Hence, it is very easy to imagine the type of things that are experienced on a daily basis. So, the most easily digestible set of laws of the Universe should be amenable to interpretation in terms of macroscopic observations. Unlike the current state of quantum mechanics, whose concepts are very hard to describe in operation, it would be preferable to work with a set of fundamental properties that are intelligible with the intuitive concepts of classical mechanics. This may seem irrelevant, given the current standing of quantum mechanics. However, the first goal here is to determine if free will is possible at all, when the highest standard is applied. The question of compatibility with actual knowledge about the real world must come later.

Another relevant preference is to have a set of physical laws that work without exception. This is desirable, as shown above, because freedom cannot be useful in material contexts with inconsistent laws of material activity. Yet, these unfailing laws must also allow for islands of material indetermination, enabling the operation of free will. This brings up another concern: how do these islands emerge? The stated preference was to have them dependent on the deterministic physical laws, but how does one get exceptions dependent upon unfailing laws? One possibility is to simply assume that the world is such that, given certain configurations, undetermined events become possible. This strategy is not satisfactory, because it implies a mysterious foundation for undetermined events. On the surface, the model may appear simpler, but it requires a confounding background mechanism for enforcement, which makes the whole operation of the Universe insufficiently intelligible. The highest standard for clarity, invoked above, demands that every event should have an explanation in terms of something that made it

possible in an explicit manner. Therefore, it is preferable to look for a model of the world, in which the potential for indeterminism is an omnipresent property, even though it could only manifest in special cases. This way, a description of the original properties of the Universe should be sufficient to describe all the subsequent manifestations.

In sum, the goal is to describe a universe, in which fundamental properties are designed to display open determinism in a manner that can be explained with nothing but the concepts of classical mechanics. The challenge is to find a mechanism for non-contradictory local failures of determinism. A recent contribution to this topic was made by John Norton, who made a formal demonstration of the failure of the principle of causality in the context of Newtonian mechanics[39]. In theory, a macroscopic object can be found at rest in a non-linear environment, when all forces acting on it balance out, but the balance can also be unstable. The slightest displacement from the equilibrium point would cause the object to start accelerating in the direction of the initial force. Norton has analyzed the example of an ideal ball that is perfectly balanced on the tip of a specially shaped dome. He has shown that the formalism of Newtonian mechanics incorporates the possibility of spontaneous motion of the ball, which means that the ball could end up rolling in arbitrary directions, without predetermined outcomes. This is a very interesting example, but it sounds counterintuitive. It does show that the equations of classical physics can have unexpected implications, but it violates the qualitative content of Newtonian physics. Newton's laws describe all changes in motion as explicit outcomes of real sources of action. Spontaneous motion is not included in these principles. Hence, Norton's work simply shows that the formalism is more inclusive than the theory that it is

[39] See John D. Norton, "Causation as Folk Science", *Philosopher's Imprint*, Vol. 3, No. 4, pp. 1-22 (2003).

supposed to describe. Insofar as the goal is to find room for indeterminism without violating material causality, this demonstration falls short. To prove that one equation has several equivalent solutions is not the same as proving that a real universe with deterministic rules must necessarily contain violations of determinism. The equation alone cannot tell us whether a balanced object would maintain its state indefinitely or collapse spontaneously in the real world. It is possible that at least one universe will contain rules of operation in which unstable equilibriums never collapse spontaneously.

This failure is nonetheless instructive. It did not work because it involved spontaneous motion. If, on the other hand, an object were balanced in the same environment, while also having an internal property that induced unavoidable constant fluctuations in its position, a collapse of the equilibrium position would be inevitable, without any break in classical material causality. We could further assume that such fluctuations in position are fundamental and omnipresent, perhaps even essential for the manifestation of all kinds of motion. Moreover, if these fluctuations were fundamentally random, then their effect would not be predetermined. At the same time, the macroscopic manifestation of determinism could be recovered by restricting the effect of such local freedom exclusively to contexts with perfect equilibrium in non-linear arrangements. In these special contexts, the environment could amplify the effect of such otherwise inconsequential elementary steps. As a result, unstable equilibriums could degenerate into one out of several possible chains of events with distinguishable macroscopic outcomes. Finally, if the details of elementary fluctuations were sensitive to well-defined metaphysical influences, then determinism would fail without any violation of

deterministic laws.[40] The stipulated mechanism cannot be expected to occur very often in Nature, given its delicate state, and it must be inevitably destroyed after each instance of consequential action. In contrast, the brain of a person can be assumed to contain a dedicated region, in which unstable equilibriums with undetermined outcomes are constantly recreated. As shown earlier in this essay, such a mechanism would be sufficient to ensure the meaningful and intelligible operation of open determinism. Even though determinism never fails, it is insufficient to determine all outcomes, for the simple reason that its rules enable the emergence of unstable equilibriums with undetermined evolution. These non-linear states can be described as gateways for freedom, because they allow the possibility of well-defined external directives (such as from the mind to the body) acting as causes for the particular mode of degeneration of any unstable equilibrium. Chains of events could further follow from such microscopic events, leading to the materialization of intended macroscopic outcomes.

The remaining question is: how to make this approach verifiable? The operation of non-physical properties cannot be made directly observable. Though, it is apparent that the physical properties must be able to accommodate them. Hence, we are looking for relevant physical markers that could be used to test whether any specific universe is compatible with the presented model of free will. From the start, it is clear that such a model must contain a fundamental level of matter, with indivisible simple constituents. If non-material causation were to be exercised over a complex entity, then the motion of the same entity would not be reducible to the motion of its constituents. A contradiction in the operation of physical laws would follow. Furthermore, non-physical causation could

[40] This model is very similar to the one proposed by Robert Kane in his book on *The Significance of Free Will* (Oxford, 1998), with the important difference that he assumed the degeneration of non-linear states as a consequence of indeterminate quantum fluctuations.

not be omnipresent in an intelligible way, unless the same elementary entities were constrained to move in discrete steps. An entity in continuously constant motion would have to change its momentum somehow, in order to accommodate non-physical determination. Yet, this would result in a violation of its physical properties. Accordingly, the universe in question must contain an irreducible fundamental level of matter with discrete indivisible entities, moving in discrete steps.

Furthermore, the elementary discrete motion is intended to create opportunities for non-physically determined choice. It is desirable for these opportunities to arise in a natural way, via some kind of intuitive mechanism. Accordingly, it is necessary to postulate the existence of some sort of environment for elementary motion, which makes undetermined choices unavoidable. For example, if there was some sort of pattern of symmetric obstacles for rectilinear motion, elementary entities would be required to "choose" which way to go around them. The simplest mechanism for this would be an elastic medium with holes, such as a texture of interwoven strings. With this in mind, one can visualize fundamental entities in the form of indivisible units of matter, which are constrained by a physical law to display indestructible constant motion. At some macroscopic level, this motion would appear continuous and rectilinear. At the microscopic level, the same motion would consist of discrete steps around void areas, such that every step is a choice among equivalent ways to cross the mentioned empty patches. Note that the elementary discrete motion *produces* the parameters of apparent macroscopic motion. Therefore, it cannot contradict them.

If elementary entities were allowed to interact via direct collisions, the fundamental parameters of indestructible motion could not be preserved in a self-

consistent manner. The direction of motion and its other parameters would no longer be reducible to the effects of specified elementary steps. Also, it would be very difficult to ensure that open determinism is consequential in limited cases only. The exact details of position must be relevant during direct impact, contrary to the intention to have nothing but exceptional effects from them. Accordingly, one more universal law is needed, enforcing an exclusion principle that prevents any kind of direct contact between elementary entities. Conveniently, a medium has been already introduced as a mechanism for unavoidable elementary choices. Hence, elementary entities must behave like constant oscillators, producing waves with point-like sources at every step on the medium. Moreover, elementary motion must unfold such as to prevent any two elementary entities from coming closer than one wavelength from each other, in order to satisfy the conditions stipulated above. Within such rules, elementary entities must have a constant effect on their medium, subjecting it to dynamic changes, and their interactions would consist in changes of their trajectory under the effect of the medium.

Within the stipulated restrictions, it is possible to describe a fundamental process of motion, in which elementary discrete entities move in discrete steps on a solid elastic medium. By design, these entities would behave as if programmed to keep constant contact with the medium, and also to make fixed numbers of steps during constant units of time. Each step should involve a choice between two or more available positions. These choices must be arbitrary, but also inconsequential, because they cannot violate the macroscopic pattern of rectilinear motion. Moreover, different entities must only be allowed to interact through the effects of their waves on the medium. This description ensures that the propensity for undetermined action is omnipresent, even if

inconsequential, with the exception of predictable occurrences of manifestation. In special environments, in which a macroscopic object is balanced on a point in space in some sort of unstable equilibrium, the same indestructible motion will cause the collapse of the arrangement in a physically undetermined way. Remarkably, this degeneration would not violate any conservation principle, including the conservation of energy, because indestructible motion is the determining factor for all symmetries of such a universe. The source of indestructible motion could be described as similar or related to the source of the will to act, in the case of rational beings that inhabit the corresponding world. Hence, it is possible to have unfailing material laws and the propensity for free will in the same environment, without any contradiction. Though, both of these properties must be properly described as internal manifestations, as seen from inside the universe, at any macroscopic level of observation. As seen from outside, the physical symmetries would arise from pre-programmed patterns of elementary motion with no prior physical cause, while freedom would be meaningful and undetermined only as an intermediary stage between complete ignorance and perfect knowledge for individual subjects.

As a corollary of the above, some universes can be hospitable for the meaningful exercise of free will. Yet, every instantiation of such a universe must contain several unmistakable physical properties, whenever its fundamental laws are mutually compatible without any contradiction. Firstly, the universe must have a fundamental level of material organization, which determines the properties of all macroscopic phenomena. This means that matter cannot be infinitely divisible in such contexts. Secondly, all entities must be discrete at the fundamental level, having constant and indestructible properties. Thirdly, fundamental interactions must be mediated. Finally, the fundamental

entities and processes must be well-defined and clearly intelligible in terms of macroscopic analogies, as seen by internal observers. These are all properties that are experimentally verifiable, at least in principle. Therefore, the hypothesis of free will can be developed in a testable manner, even in the case of the most stringent model, as defined in this text.

Summary and Conclusions

Free will is a concept that seems to fit best of all in a dualistic description of the world. An intuitive picture of a mental entity governing a material body is required to make the most benefit from it. The mental entity (the subject) must have the power to decide what to do and how to act, independently from external influences (material as well as mental), and this must translate into well defined operations of the body in its material context, exactly as intended. In short, the subject must be the "ghost in the machine". Unfortunately, this description engenders several major problems. If the subject had perfect knowledge about the world (regardless of its source), then it would know what to do in every situation. Would this make the subject free? If knowledge was sufficient to determine the realization of an action, the subject would be an automaton. Yet, if the subject had freedom from knowledge, what would be the ground for the decision? If it was some other predetermined sense or emotion, it would also eliminate the element of freedom. Though, an action based on nothing specific would be arbitrary and irrelevant for its context. Does that mean that free will is necessarily blind and arbitrary? If so, what benefit can it bring to a subject? How would the subject be superior

to a mechanical device that is simply emitting prescriptions for action at random? What is the point of having a "ghost in the machine" at all?

The proposal of this essay was to think of free will as if it was a solution, rather than a problem. Free will can be an arbitrary activity without being meaningless, if it is subordinated to a non-arbitrary process. When a deterministic context produces conflicting (equivalent) instructions for action, and the body can only do one, something has to break the dead-lock. The agent needs to make a decision, based on some sort of criteria that it is supposed to have, but the assumption is that it has insufficient knowledge for a decision. Free will enters this process in the form of a transcendental drive to make a decision, which is both blind and eager to accept whatever sense of identity is present at the time and place where the decision is to happen. This sense is the self-perception of the subject about the type of personality that it has, based on its own feeling and experiences (e.g., "I always do <this or that>", or "I like <this or that>", or "I wish to become <this or that> and therefore I must do <this or that>"). If the sense of self relative to all grounds for action is insufficient for a preference, the decision will be arbitrary, or else determined by external factors. Accordingly, this will to act is supposed to be arbitrary for states with poor knowledge, and fully constrained for states with perfect knowledge. In other words, it must be provisionally free, serving as a developmental tool for the subject. Such a description of free will is not *a priori* satisfactory, but there are contexts in which it can be meaningful.

The crucial element of this argument is the claim that some actions can be arbitrary without lacking in relevance, especially in the case of learning activities based on the principle of trial and error. This was illustrated with the example of a sorting

procedure, in which a population of objects is separated in two groups on the basis of a predetermined trait that is not immediately perceived. If, for example, the goal is to sort a number of balls into designated baskets by color, then the final state of a reliable sorting operation is predetermined. Every step in the sorting procedure is also meaningful, because it is governed by explicit tasks, aimed at fulfilling the sorting procedure. However, when the means of observation are limited and the subject has no immediate knowledge about the properties of each individual object, then the sorting procedure will contain random steps. Each ball must be chosen at random and analyzed through an imperfect process of observation. Given this element of irreducible randomness at the moment of choice, plus the possibility of mistakes and the local environmental complexities that might intervene, the content of the sorting baskets at each intermediary stage cannot be predetermined. Though, the final state of the baskets is predetermined and it can be, in principle, obtained after repeating the sorting procedure sufficiently many times. With this analogy in mind, free will can be described as the driving force that pushes the subject to make a meaningful decision in the absence of sufficient grounds for action, as part of a lengthy process of mental development. Ideally, a subject could reach a level of maturity and knowledge, when arbitrary steps are no longer required, and the will to act alone remains functional. In the case of human beings, with limited life-span and complex existential environments, this final stage may never be attained. Though, even in the ideal state of perfect knowledge, the subject retains freedom in a practical sense, when it needs to act independently from the externally determined constraints of the body. In other words, the subject can still act as the true source of action in its material environment, being in effect free from external forces during

decision making. The choice would be predictable intellectually, even if physically undetermined. Even in this ideal state, the subject would be free in a meaningful way, because its knowledge about the external world would be relevant, given the described process of acquisition. (No longer “free to…”, but still “free from…”).

If mental processes are supported by physical processes, the element of irreducible randomness in the mind must have a corresponding material process in the body. This requirement is introduced in order to avoid any contradiction between the mental and the physical aspects of decision-making. Conveniently, an undetermined physical process could serve as a gateway for translating mental decisions into physical activities, if its outcomes were sensitive to the agency of the stipulated transcendental element. In other words, conflicting drives for action in the mind should be produced by material entities whose mutual forces are balanced in unstable equilibriums. The degeneration of this physical state must not be caused by any material influence, in order to qualify as an effect of free will. Hence, it is possible to exercise mental determinism over matter, even if the mind is a direct reflection of its physical substratum. The transcendental element may be imagined as the actual agent that “reads” the mind and “tips” the physical arrangement one way or another. Alternatively, all physical entities can be described as “willing” to move freely, within pre-established boundaries that act as Laws of Nature. The mentioned unstable equilibriums would be the exceptional places that allow this phenomenon to manifest. In plain terms, elementary physical entities are supposed to produce the manifestation of all mental directives, be it the Laws of Nature, or the contextual arrangements that might be found in brains, or even their own preferences. Yet, the order of priority of these directives would be determined by the

level of association: the universal laws would trump local collective processes, which would override individual preferences. Accordingly, mental processes in the brains of individual thinkers would be free to manifest only when they do not contradict the operation of macroscopic physical laws. Furthermore, undetermined physical processes should not be arbitrary, whenever clear mental directives are locally in effect.

It is remarkable to discover that such a picture – complex as it may seem – does not contain any sort of unavoidable contradiction. Though, coherence is not *a priori* guaranteed either. The relevant conclusion is that free will can be compatible with a fundamentally lawful material context, even in a manner that fits human intuitions about macroscopic observations. Moreover, this correspondence can be recognizable by intelligent observers from inside the universe. As shown in the text, several material properties must be amenable to empirical verification in such cases. In particular, the universe in question must contain a fundamental level of material organization, with discrete and indivisible mobile entities that display indestructible properties of motion. There should also be a physical universal medium, determining the patterns of motion and interaction among elementary entities. The entire universe must be governed by the same set of laws, implying that macroscopic processes should follow from microscopic principles of operation without any conceptual breakdown in interpretation. These major properties have clear experimental implications. Therefore, a subject can always verify if the surrounding world is compatible with freedom in a self-consistent way or not. Because of the contingent nature of this model, full verification of these properties would not guarantee the true existence of free will. It would only guarantee that the universe is in principle compatible with its exercise. Still, this would be enough to verify

compatibility between the intuitive self-perception of a subject and its existential context. As shown in the previous chapter, this is all that is necessary for the validation of human observations. As a corollary, the problem of free will is no longer a conceptual problem. It is an empirical problem. Human beings can determine if they can have free will in their own Universe by performing a set of relevant physical experiments.

IV. THE PHYSICS OF FREEDOM

Abstract: This chapter is focused on the problem of compatibility between the main three material preconditions for freedom and the physical properties of our Universe. A functionally fundamental level of matter imposes a limit to the applicability of reductionist analysis. The marker of such a limit is the inevitable use of theory-independent constants in physical models. An all-pervasive medium can reveal its presence through the parameters of propagation of changes inside static fields. Elementary discrete sources of waves are expected to operate with constant units of action. Their reality would have to become manifest in the quantized nature of energy. All of the required markers appear to be compatible with existing knowledge about our Universe.

The preceding philosophical study has produced an important conclusion: rational self-conscious beings can only exercise their faculties in a meaningful way in Universes that are completely intelligible in terms of well-defined observable objects. Moreover, the fundamental properties of such Universes must include three verifiable components: a primary structural level where matter is no longer divisible, a physical medium for the propagation of energy in the form of waves, and a score of discrete entities that act as sources of waves on the mentioned medium. It is not necessary to be an expert in physics in order to notice that these properties are at odds with the leading theories of our time. The possibility of understanding the microscopic world with macroscopic analogies is denied by the Copenhagen interpretation in quantum mechanics. The existence of a physical medium is supposed to be ruled out by numerous experimental and theoretical

considerations. The remaining properties, related to the possibility of indivisible matter, are not explicitly ruled out by current theories, but they are not anticipated either. If this state of facts in science were to be taken at face value, without critical analysis, the implications would be very grave indeed. On the one hand, this could mean that rational self-consciousness is an illusion. Yet, this is in outright contradiction with the very fact of existence of science. On the other hand, the observable Universe might be illusory (or inauthentic, in terms of the presented argument). Both of these alternatives are troubling in their own right. For the purposes of this dissertation, it is sufficient to note that the hypothesis of emergence of a universal political culture (on the basis of the model discussed above) would have to be discarded.

Thus, it is vital for this project to establish if the specified properties are compatible with existing knowledge about physical phenomena, despite the large number of authoritative interpretive claims to the contrary. In the following sections of this chapter it will be shown that such compatibility can, indeed, be demonstrated. Moreover, the specific configuration of material markers, as prescribed by the earlier chapters of the thesis, appears to provide enticing clues to alternative solutions that go beyond the limits of currently known phenomena. If this were to set in motion a successful trend, scientific knowledge could become the basis for a major cultural paradigm shift.

The bottom of all matter

What is the structural organization of matter in our Universe? Is it infinitely reducible to lower and lower levels, or does it have a fundamental level that prevents any further decomposition? This question has two aspects. One can focus on the word

"infinitely", and try to establish if the Universe, as a matter of fact, has a finite or infinite number of structural levels. Alternatively, one can focus on the word "reducible", and limit the investigation to the methodological dimension. The first aspect is a good subject for interminable debates, but the second one is much more manageable. Reductionism implies the operation of an all-pervading governing dynamics, which can be applied consistently to each level of material organization. In plain terms, the properties of molecules can be explained by the interactions of atomic components, which are determined by the interaction of subatomic particles, and so on. The crucial point is that the lower-level processes must be sufficient to explain the supervenient dynamics in full. This implies that a top-down investigation of the properties of matter should never require the postulation of new principles of interaction for any level. In short, perfect reductionism implies infinite divisibility of matter. If it works without any break in continuity, there can be no fundamental level of matter in the Universe. Yet, the opposite is not necessarily true.

The Universe might also have one or several unusual levels, where the known principles of material organization do not apply, but this does not necessarily imply the true existence of a "bottom" level of matter. Unusual levels could also be infinite. The only question that is methodologically relevant is the ability to rely on lower levels of organization for scientific explanation. Hence, there are many types of molecules in various states at different times, but all of them can be explained by reference to a smaller set of atomic components and the interactions among them. As long as there is variation, scientists can look for theories to explain it. If their models can reproduce the details of variation, they should also predict numerous manifestations even if the elements of the

theory are not directly observable. On the other hand, if there is no diversity at some level of matter, then it is no longer possible or necessary to come up with such models. If a level like this also happens to be unobservable, then theoretical work has reached a limit that cannot be overcome in any productive way. The Universe may or may not have lower levels of organization, but they become scientifically irrelevant. From a methodological point of view, this is a fundamental level of matter, with no further room or use for reductionism.

A level of matter, which is methodologically fundamental, must have a unique set of properties. It must determine the governing dynamics that applies vertically to all superior levels, but it cannot obey the same rules. If it did, it would be reducible to a lower level. Therefore, it must have a special set of rules of operation, which produce the governing dynamics for the remaining material superstructure. If it did not have any well-defined properties, it would not be able to determine anything. Presumably, its properties come from a process that is beyond the reach of any theory (for the reason explained above). If so, the fundamental level must have a set of well-defined parameters, which must be treated as theory-independent fundamental constants of Nature. To sum up, a fundamental level must have constant properties and exceptional laws of interaction, but it must determine all observables in the Universe in a consistent way.

Does our Universe have a methodologically fundamental level of matter? In order to answer this question, one must look for two types of markers: theory independent physical constants and the operation of processes that are not reducible to any sort of lower-level mechanics. As it happens, there are more than one fundamental constants in our Universe, even thought their significance is not usually evaluated in this way. For

example, there is no known mechanism to predict the exact value of the speed of light, or Planck's constant. They just happen to have very precise values, and there is no going around that. Without the assumption of quantization, theoretical models cannot be reconciled with the known properties of electromagnetic radiation. Indeed, the determination of the exact value of Planck's constant is one of the most important scientific discoveries of the twentieth century. Similarly, the speed of light is known to be both constant and invariant in any frame of measurement. This is another raw fact that must be adopted for what it is in any theoretical model. There is no meaningful way to explain why this speed has the exact value that it does, which is to say that no mechanism – internal to the Universe – can predict it. At a more general scale, one might even ask: why is there motion in the Universe, and why does it have to be conserved? The only way to suggest an answer to this question is to invoke an extraneous source, coupled with some sort of principle that acts as a Law of Nature. In other words, from an internal perspective, these properties "just are", and their manifestation is theory independent.

There is yet another way to argue in favor of limited reductionism in our Universe. The properties of a fundamental level of matter are not fully understandable from inside, without invoking external sources for their manifestation. This means that reductionist approaches to the properties of matter must collapse at some point. In a context with infinite reductionism, such a collapse should not happen. Ergo, the gap between the principles of quantum mechanics and classical mechanics is only compatible with one scenario – the reality of a methodologically fundamental level of matter. Caution is advised here, however, because the specified gap might be entirely produced by a limitation in the means of observation. For example, the dynamics of macroscopic

objects (e.g. billiard balls) may be explained in a manner that ignores the details of their microscopic interactions, without denying the existence of such causative elements. Scientists could be reaching an interpretive gap by making mistaken assumptions about unobservable properties of quanta. It is not necessary to assume that the end of reductionism has bean reached already. On the other hand, such an assumption *would* be justified if the properties of quanta were coming from a set of elementary units without any variation in behavior. In other words, they should all be identical, and display the same limited parameters of motion. As shown above, the end of reductionism is imposed by the end of variation in physical properties. Yet, by taking into account the details of the previous paragraph, it is hard to deny the possibility of such a fundamental level of matter (at least, in a methodological sense). The fundamental irreducible unit of action in quantum mechanics is discrete and equal for all entities – it corresponds to Planck's constant. Moreover, the speed of propagation of quanta is dependent on the value of the speed of light in all interactions. If so, the gap between quantum mechanics and classical mechanics and the operation of theory independent properties and processes at the fundamental level of matter amount to a very strong argument in favor of limited reductionism in our Universe. As a corollary, there are sound reasons in favor of a basic level of matter, as required for the operation of rational self-consciousness. The content of modern physics does not constrain us to rule this property out.

Mediation

The notion of mediation is related to one of the most intuitive concepts in physics. Insofar as waves are oscillations of elastic entities, it seems perfectly appropriate to

suspect the existence of a medium wherever it is possible to detect wave-like phenomena. The observation of vibrations indicates the existence of something that is vibrating (like smoke and fire). Similarly, if an oscillation is transferred between two well-defined objects, it stands to reason that something had to be involved in that transfer, effectively mediating the propagation of the oscillation from one body to the other. If this was not the case, one would have to assume that an oscillation in the second body emerged without a physical cause, in violation of energy conservation. Nevertheless, the intuitive nature of wave-like phenomena also leads to very clear predictions for certain observable phenomena. For example, if light (and all other types of electromagnetic radiation) were made of waves, as suggested by its observable patterns in interferometric experiments, the medium for these waves would serve as a special frame of reference. The speed of any observer relative to a wave would implicitly betray the speed of the observer relative to the medium[41]. Moreover, the constant speed of waves relative to the medium implies the possibility of an observable variation in the speed of light relative to non-stationary observers. If two observers are moving relative to each other, at least one of them is moving relative to the medium. They should not be able to see the same speed of light. In other words, the hypothesis that the wave-like properties of light result from real waves on a real medium has two clear implications: there should be a preferred frame of reference for all motion in the Universe, and the speed of light should vary from one experiment to another, according to the relative state of the observer. Both of these properties are rejected by modern physics. Einstein's theory of relativity[42] (which is reasonably well supported by evidence) is based on the impossibility of observation of

[41] See, for example, R. Karplus and F. Brunschwig's *Introductory Physics* (2003), or any other introductory physics textbook.
[42] A. Einstein, *Relativity: The Special and General Theory* (Penguin Classics, 2006).

preferred frames of reference, and the Michelson-Morley experiment[43] (with its numerous subsequent versions) confirmed the invariance of the speed of light. Does this mean that there is no room for a physical medium in our Universe?

The current rule of thumb in physics is to assume that a medium (like the luminiferous aether of the nineteenth century) does not exist. This is a methodological assumption, rather than an ontological conclusion, because the non-existence of a universal medium is not independently confirmed or ruled out.[44] It just might be the case that a fundamental medium could exist without any relativistic effect on the speed of wave propagation. Such a possibility was rigorously examined theoretically, in particular by H. A. Lorentz[45], and found to be plausible. If the medium was deformed in special ways by the motion of inertial frames, the speed of waves may become observationally invariant. Notwithstanding, it is not enough to show that an unobservable phenomenon is plausible. Ontological assumptions must be justified by demonstrating their theoretical advantages. Do they simplify our understanding of Nature? Do they expand the scope of existing theories? Historically, the assumption of mediation was seen as a source of unnecessary complications in modern physics[46]. On the one hand, it did not help the discovery of new phenomena. On the other hand, it seemed to demand special properties (and additional assumptions) in order to fit the observation of invariance. Why should it be that all known media serve reliably as preferred frames of reference for their internal processes, but not this hypothetical all-pervading medium? It seemed a little suspect, if not "too convenient", for the medium to behave such as to conceal its own existence. In

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[43] A. Michelson and E. Morley, *Am. J. Sci.* 34 (203), pp: 333–345 (1887).
[44] A. Einstein, *Ether and the Theory of Relativity*, http://www.mountainman.com.au/aether_0.html .
[45] H. A. Lorentz, *The Principle of Relativity* (Dover, 1952).
[46] For a concise bibliography of modern scientific approaches to mediation, with direct links, this website is a good starting point: http://www.mountainman.com.au/aetherqr.htm .

any case, the required description of the Universe appeared to be unnecessarily complicated, without a corresponding increase in predictive power.

There is an important interpretive principle in science, known as Ockham's razor[47]. It is based on the belief that the Universe is the most efficient system possible and does not contain superfluous entities. If something can be done without, or if it complicates explanatory models unnecessarily, then it is probably not a real component of the Universe. According to this principle, the hypothesis of mediation should be discarded, if it demands unnecessary assumptions without predicting new phenomena. Indeed, this is the way it was treated throughout the 20th century. Still, the topic came back to the forefront in the recent years, with renewed interest in the theoretical and experimental aspects of mediation[48]. Most notably, a recent paper by Barceló and Jannes[49], showed that our ability to detect preferred frames of reference in elastic media comes from our status as external observers. Experimenters from inside any condensed matter medium, who had no access to external grounded rigid rods, would be unable to record the effects of motion relative to the same medium. In other words, Einstein's theory of relativity would apply to these environments as well, even though we, external observers, could see clearly that a preferred frame of reference exists. This means that the existence of an all-pervading universal medium with invariant waves would not be an exceptional phenomenon. It would be a type of medium similar to all others. Assuming that it is real, we should not be able to detect its distinguishable properties because of our

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[47] http://en.wikipedia.org/wiki/Ockham_razor

[48] See, for example, M. Consoli and E. Costanzo, *Phys. Lett. A*, vol. 333, pp: 355-363 (2004), and references therein. This paper is referenced because it prompted a fruitful correspondence with one of the authors (M. Consoli), in the early stages of the presented research. Readers with a high interest in this topic are advised to run a search at www.arxiv.org/find where a large collection of recent papers on the subject can be found.

[49] C. Barceló and G. Jannes, *Found. Phys.*, vol. 38: pp: 191–199 (2008).

complete immersion in it. Therefore, this hypothesis does not impose on us any additional assumption, avoiding elimination by Ockham's razor.

To be sure, the manifestation of electromagnetic waves is different from other classical waves, but not because the medium has a different essence. It is the waves themselves that are more complex than originally expected, as emphasized by the particle/wave dualism. This statement can be explained with greater effect by reference to the famous Michelson-Morley experiment[50]. The reasoning behind this test was based on the hypothesis that light is a simple wave, propagating in aether. Accordingly, the speed of light had to be constant relative to its medium, but not relative to the observers that move inside it. Given the known cosmic motion of the Earth, light should have different speeds in different directions on the surface of the planet (and also different speeds in the same direction at different times of the day). The stipulated difference was theoretically predicted and found to be experimentally detectable. Eventually, the experiment was carried out and the corresponding predictions were not confirmed. This discovery was used as a crucial argument against the reality of a medium for the propagation of light waves. At first sight, this conclusion seems perfectly valid. On closer inspection, it contains a subtle flaw. If light was a wave, it was supposed to have a variable speed, according to the argument behind the experiment. The observable element was relative speed in orthogonal directions. Thus, if the speed was found to be invariant, then it had to mean (according to the same original argument) that the speed of light is not the speed of a wave. This could mean that light is not a wave, in which case its speed cannot tell us anything about the existence or non-existence of a medium. If light is still assumed to be

[50] A. Michelson and E. Morley, *Op. cit*. A good introduction can be found at the Wikipedia website http://en.wikipedia.org/wiki/Michelson-Morley_experiment and many other places on the web.

a wave, and then it is concluded that there is no medium for its propagation, then light cannot be a wave for the simple reason that there is no medium for it to propagate. So, light is not a wave, if it is a wave. The only way to avoid this contradiction is to assume that light – if it is a wave – propagates inside a relativistic invariant medium, in which case – again – its speed cannot be used for any conclusion about the existence of non-existence of the medium.

An interesting hypothesis to consider is that both of these latter arguments could be simultaneously true. In other words, the speed of light may not be the speed of a wave, and still its wave-like properties could come from real waves with invariant speed. This would mean that the speed of such waves is a different phenomenon, yet to be verified. Consider the fact that Einstein proposed his photon-hypothesis[51] only a few years after the experiment of Michelson and Morley, when scientists were still trying to makes sense of it. According to the corpuscular model of light, the fundamental constituents of electromagnetic radiation had to be some sort of hypothetical particles. If so, then the speed of light had to be the speed of its component photons. Furthermore, if the speed of light was the speed of particles, then it could not be simultaneously the speed of some sort of simple waves. Therefore, the invariant speed of light could not be used to suggest anything relevant about the existence or non-existence of a universal medium. The interpretative value of the mentioned experiment had to be compromised. As it is known, Einstein chose to argue that the existence of a medium had become superfluous[52]. This is consistent with his special theory of relativity[53], developed at the same time, and also

[51] A. Einstein, *Annalen der Physik*, vol. 17, pp: 132-148 (1995).
[52] A. Einstein and L. Infeld, *The Evolution of Physics*, (Touchstone, 1967).
[53] A. Einstein, *Annalen der Physik*, vol. 17, p. 891 (1995). Online text of English translation can be found at this link: www.fourmilab.ch/etexts/einstein/specrel/www/ .

with the fact that a particle does not need a medium to explain or predict the parameters of its motion. Unfortunately, this encouraged the ungrounded interpretation that Michelson and Morley have proven the non-existence of a universal medium. Note that Einstein's photon model explained only one aspect of electromagnetic radiation. The wave-like properties were never ruled out by experiment, to this day (which is why there is still the unresolved problem of dualism). It seems reasonable to assume that wave-like properties emerge because there are physical waves at work. If so, something would have to enable their operation, and this brings in again the possibility of a medium for their propagation. In other words, the hypothesis of mediation has become superfluous for many aspects of light, but not for all of them. The problem is to identify the unique property that is responsible for all the known wave-like effects and to establish if it is verifiable or not. Until this is done, the issue of mediation is far from being solved. (Or else, scientists must feel constrained to postulate the reality of non-physical probability waves, and other similar processes).

Several well-known theoretical models in modern physics discuss the possibility of waves that are instrumental in the behavior of light, without necessarily propagating at the speed of light. They are known as pilot-wave models, such as the proposal of Louis DeBroglie[54] that inspired the school of thought of David Bohm[55]. Little is known about the nature of these waves, and it is often assumed that they should have a superluminal speed, in violation of the so-called Einstein locality[56]. The ontological status of such waves is still somewhat of a mystery, and there is no apparent consensus on the

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[54] L. de Broglie, *Non-linear Wave Mechanics: A Causal Interpretation.* (Elsevier, 1960).
[55] D. Bohm and B. Hiley, *The Undivided Universe: An ontological interpretation of quantum theory*. (Routledge, 1993).
[56] The principle that no form of propagating matter can exceed the speed of light.

possibility of confirming their reality. Such a state is unsatisfactory for the purpose of this thesis, because it is quite important to have a reliable answer about the nature of fundamental waves in physics. If physics cannot provide explicit answer to this question, then the research program must be adjusted such as to address the narrow concern that matters to the project. In other words, we need to understand – at the very least – if there is room in modern physical knowledge for a fundamental description of matter in terms of the qualities listed in the previous chapter. More specifically, is it possible to describe electromagnetic radiation in terms of propagating sources of real waves, and would this be a verifiable proposition? As it turns out, the ground was fertile for such a hypothesis, because the most successful models for the behavior of light already are based on the so-called Huygens' Principle[57]. This is a concept that treats light as if it had source of secondary waves at all points. Hence, by assuming that these secondary waves are in fact produced by real sources of waves, one can get to a new conclusion about the nature of light. Classical electro-magnetism is based on a formal description of the interaction of static electric and magnetic fields, without going into details about the source of these manifestations[58]. If it was possible to explain the manifestation of static phenomena as an effect of elementary running waves, then it should be also possible to identify a verifiable mechanism for such a process. To be exact, the real operation of elementary running waves should reveal itself as the speed of propagation of changes within static fields, especially if this speed was not equal to the speed of light.

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[57] See, for example, http://en.wikipedia.org/wiki/Huygens-Fresnel_principle and any optics textbook, such as F. Jenkins and H.White, *Fundamentals of Optics* (McGraw-Hill, 2001).

[58] J. Reitz, F. Milford and A. Christy, *Foundations of Electromagnetic Theory*, (Addison Wesley, 2008). Also, R. Feynman, *The Feynman Lectures of Physics,* (Addison Wesley Longman, 1970).

The conclusion from the previous paragraph came about as a result of considerable analytical work, whence it has become apparent that a proper solution depends on the possibility of understanding the physical nature of static fields. This concept is so important for this discussion, that it must be explained here in greater detail. Static fields are very well-known phenomena, the most common types being electrostatic, magnetic and gravitational. They are described mathematically as scalar fields[59], when their potential energy at every spatial coordinate is fixed, other things being equal, because it can be described by a single scalar value for each point (an exact number, not a variable or a function). Energy is distributed according to well-defined rules in static fields. In most cases, it diminishes with distance from the source, and it is not known why such rules are in effect. However, it is generally assumed that the real mechanism behind such observations must also be static. In other words, something is supposed to be there in an unchanging shape, determining the known parameters of a field. This is in contrast to the conclusions of the preceding philosophical analysis, which required the existence of elementary units of matter that act as sources of waves. Accordingly, it has become imperative to understand if a non-static process could also produce the same manifestations, and it was found that it can. This can be illustrated by analogy with surface waves propagating in a ripple tank. Ring-shaped waves propagate away from the source of excitation, and their amplitude diminishes with distance. Moreover, their potential energy at every point on the surface of propagation is proportional to the amplitude. If the waves are generated at a constant rate, and if they propagate away at the same rate, then the total energy of any finite surface that includes the source must also be constant. Consequently, the collective energy of surface waves could be described

[59] http://en.wikipedia.org/wiki/Scalar_field

mathematically as a scalar field, if they are produced by constant sources with fixed coordinates. By implication, fundamental physical static fields (such as electrostatic and magnetic) could also be produced by unobservable dynamic mechanisms that contain running waves (rather than standing waves). It is quite possible (until proven otherwise by experiment) that quantum entities – such as photons and electrons – are really composed of elementary entities that serve as sources for their own static fields[60].

The hypothesis described above is also easy to verify experimentally. If a source of waves is switched off, the potential energy distribution in the medium should change with the speed of propagation of the constituent running waves. The last wave can be visualized as the barrier between the initial state of the field, and its final state. By analogy, the rate of propagation of changes within any static field should be equal to the speed of propagation of its fundamental waves, whenever it is produced by running waves. If so, the reality of elementary running waves could be verified simply by testing the speed of propagation of magnetic or electrostatic pulses. Yet, this hypothetical phenomenon is still untested, because it appears that it was never suspected to exist before. The fundamental equations of classical electromagnetism, formulated by Maxwell, can be used to predict the rate of alternation between magnetic and electric components in electromagnetic waves. In fact, Maxwell is particularly famous for predicting the speed of light with his equations, thereby demonstrating that light is an electromagnetic wave[61]. Nevertheless, the same equations do not predict the rate of

[60] It should be noted that electromagnetic waves are currently interpreted as summations over large numbers (infinities) of virtual photons. In particular, Quantum Electrodynamics (QED) explains all known EM phenomena with extraordinarily high experimental accuracy.
[61] http://en.wikipedia.org/wiki/James_Clerk_Maxwell

propagation of changes within any component field, treated in isolation[62]. The only way to settle this problem is by carrying out a qualified physical experiment.

It seems that magnetic fields are the best candidates for initial tests, because they are easier to manipulate. A very strong magnetic pulse could be produced simply by discharging a capacitor through an electromagnet. In order to test the speed of the pulse, an experimenter would have to place two detectors in the same direction, at different distances from the source. Knowing the time of detection and the distance between detectors, it should be easy to calculate the speed of the pulse. The problem, of course, is to achieve the high accuracy that would be required for this task. Rather than using clocks to register the time of detection directly, it may be more convenient to have some electric switch connected to the detector. This way, the effect of the discharge on the detector could be accompanied by the release of a pulse of light. The pulses of light from both detectors should be aimed towards a photodetector, placed in the direction of propagation of the magnetic pulse. Hence, the magnetic pulse would reach the first detector, triggering a co-propagating pulse of light. Then it should reach the second detector, triggering the second pulse of light. If the speed of light is equal to the speed of the magnetic pulse, then the two pulses of light should get to their detector simultaneously. If the speed of the magnetic pulse is superluminal, the second pulse of light should be the first to arrive at the detector. Once the speed of the magnetic pulses is verified conclusively, different experiments can be devised to test it for invariance.

[62] It is a well-known fact (discovered by Faraday, and covered by Maxwell's equations) that any change in the profile of an electric field produces a magnetic field, and vice versa. Hence, we are describing a process that takes place inside an electric field (or magnetic field) *while* it generates the other field.

As a corollary, there are no theoretical or experimental reasons to rule out the hypothesis of mediation. Quite the opposite – there are strong incentives to take it seriously, because it can bring important theoretical advantages and it has yet to be verified conclusively.

Wave sources

The three main properties that are required for the compatibility between free will and deterministic material processes include the existence of a fundamental level of matter, the reality of a physical medium for wave propagation at that level, as well as the existence of an unspecified quantity of identical sources of waves that travel at the speed of light. The former two properties were discussed above in the context of pre-existing arguments on the subject. Hence, the problem of fundamental levels with indivisible matter has a long tradition in philosophy[63] (even though it might be argued it did not progress much since Kant's antinomous argument against the possibility of a rational answer to this problem[64]); the problem of mediation has its own rich history with corresponding opposite interpretations[65], as shown above. In contrast, the possibility of discrete identical source of wave energy sounds like a new idea. There were hypotheses about identical elementary constituents of matter in ancient Greek philosophy[66], just like there are proposals involving discrete entities surrounded by fields in more recent qualitative work in physics, but the idea of explaining all energy in the Universe with

[63] See, for example, A. Kenny's *An Illustrated Brief History of Western Philosophy* (Blackwell, 2006).
[64] http://plato.stanford.edu/entries/kant-metaphysics
[65] E. Whittaker, *A History of the Theories of Aether and Electricity* (AIP Press, 1987).
[66] http://en.wikipedia.org/wiki/Atomism

identical *sources* of waves does not seem to have a precedent[67]. It was completely dictated by the conclusions of the metaphysical analysis that informed this dissertation. Thus, it is now important to ask: is there anything in our knowledge about physical processes that would be useful in discussing the plausibility of such a mechanism?

The answer to this question depends on the possibility of identifying a physical property that could represent indivisible discrete units of energy, serving as elementary constituents for all forms of manifestation of matter. The natural candidate for this is the unit of action known as Planck's constant. It is a well-known fact today that energy is fundamentally discrete, and that it can only exist in the form of integer increments of units that are equal to the mentioned constant[68]. It may, therefore, seem puzzling that such a hypothesis is not already considered. Though, it is a peculiarity of Planck's discovery of quantization that it was used repeatedly in many ways that were not expected from the beginning[69]. At the end of the 19th century, there were several experimental discoveries in the area of thermodynamics that lacked theoretical models for exact predictions. One of these phenomena was the fact that thermal radiation could have different frequencies that were always distributed in well-defined patterns for all types of substances. At first, the apparent difficulty was to explain the known shape of that distribution for low frequencies, and this is what Planck attempted to solve. Later, and with more accurate data at their disposal, scientists proposed other models, only to run into problems for large frequencies. Again, Planck's model was brought in to save the day. Still later, Einstein picked on this model to suggest a solution for another new discovery – the photo-electric effect. Eventually, Einstein had to engage in several

[67] To the best of my knowledge. (*G.M.*)
[68] H. Kragh, *Quantum Generations: A History of Physics in the Twentieth Century* (Princeton, 2002).
[69] T. Kuhn, *Black-Body Theory and the Quantum Discontinuity, 1894-1912* (U. Chicago Press, 1987).

debates with Planck, because the two scientists had opposite opinions about the reality of photons[70]. Einstein's model informed the development of quantum mechanics, but there are arguments in support of alternative models (known as semi-classical approaches), which suggest that particle-like photons are not essential for the correct predictions of relevant phenomena[71]. The motivation for this subchapter is to explain how a model with elementary sources of waves could incorporate the advantages of both types of approaches and help to solve this old problem.

The details of the debates about the nature of energy are highly technical, requiring advanced mathematical training. Nevertheless, the physical essence of the problem is straightforward. Every physical object can reflect or absorb radiation. When energy is absorbed, it can also be radiated back into the environment. However, it is converted from any incoming frequency to the oscillation modes that can resonate inside the molecules of the absorbing substance. A process of continuous absorption and emission of energy results in a state that is known as thermal equilibrium. In this case, radiation outside of a physical object contains only the frequencies of oscillation that are compatible with its internal resonant modes. This is called black-body radiation. To be more specific, the temperature of a physical body can be detected because it emits electro-magnetic waves of different frequencies. If the intensity of each frequency is plotted on a graph, the line that connects the values of all intensities for a continuous range of frequencies is called a spectrum. When the spectra of the same body at different temperatures are compared, an interesting property is revealed. If frequencies are plotted from least to greatest on a left-right axis, then the shape of the spectrum to the left of the

[70] C. Roychoudhuri, K. Creath, and A. Kracklauer (eds.), *The Nature of Light: What Is a Photon?* (Taylor & Francis, 2008).
[71] *Ibid.*

peak intensity is always the same for bodies in thermal equilibrium. If the temperature is increased, the relative distribution of intensities for the lower frequencies remains unchanged. Only the higher frequencies suffer dramatic changes in their relative amplitudes, increasing up to a predictable limit. The line that predicts the maximum values for all frequencies is known as the Rayleigh-Jeans curve[72], in honor of the people who gave it a precise mathematical formulation. The rule that dictates which frequency should have the highest intensity for specific temperature values is known as Wien's displacement law[73]. The existence of these patterns was too remarkable to be left without an explanation. Planck's model lead to a beautiful solution, but it also left open unexpected possibilities, as shown below.

It is relevant to point out that the shape of the Rayleigh-Jeans curve is most conveniently interpreted with the tools of statistical mechanics. In this area of study, probabilistic events are predicted on the basis of the number of combinations that enable their manifestation. For example, if there is a cube with one red surface and five white surfaces, there is only one way for a red surface to point up when the cube is thrown on the ground, but five different ways for a white surface to point up. This means that the probability of a white surface being up after an unbiased throw is five times as large as the probability of a red surface being up. It is standard practice today to analyze thermodynamics with statistical models, as if the Universe was fundamentally probabilistic[74]. For example, the evolution of any state of energy distribution in time is assumed to be dictated by entropy laws, which determine the emergence of the most

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[72] http://en.wikipedia.org/wiki/Rayleigh-Jeans_law
[73] http://en.wikipedia.org/wiki/Wien_displacement_law
[74] http://en.wikipedia.org/wiki/Thermodynamics A concise and informative article, with numerous links and references.

probable configurations. Still, this approach has the counterintuitive aspect that local violations of energy conservation are possible, even if highly unlikely. It is important to note that the black-body problem was at the nexus of debates about the nature of energy at the end of the 19th century[75]. Planck was trying to find out if energy can be explained mechanically, by reducing it to a fundamental material process, and his greatest discovery was actually a demonstration of the superiority of the statistical approaches. Thus, the fundamental discreteness of energy was revealed as a side-effect of a different kind of debate. The primary concern at the time was the ontological nature of energy in general terms, and statistical models won by revealing the unexpected fact of quantization[76]. In contrast, we can now focus only on the statistical treatment of the quantization, and show that it might work just as well in the context of a deterministic mechanical model.

The theoretical difficulties, associated with the right-hand part of the black-body radiation spectrum, are known historically as the "ultraviolet catastrophe". The term comes from the fact that early attempts to explain the problem have had catastrophic implications with respect to the expected distribution of energy in the Universe. (In other words, the "catastrophe" was discovered. It is not the discovery that was a "catastrophe", as stated erroneously in some historical accounts)[77]. The main aspects of this problem

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[75] H. Kragh, "Max Planck: The Reluctant Revolutionary", in *Physics World* (December 1, 2000) http://physicsworld.com/cws/article/print/373.

[76] T. Kuhn, *Black-Body Theory and the Quantum Discontinuity, 1894-1912* (U. Chicago Press, 1987).

[77] Chronologically, the spectrum was first observed experimentally, and explained – as perceived at the time – with insufficient accuracy for low frequencies; later Planck developed his model, in several stages, and with moderate success; then observations were expanded, and finally the theoretical models of the time were generalized to show an inconsistency with the data at the opposite end of the spectrum, as well as the "ultraviolet catastrophe". Planck's work was revived with the help of Einstein (among others) to develop a correct prediction for the known shape of the spectrum. See Kuhn's book on this subject (*Op. cit.*), for a comprehensive analysis. In contrast, some modern textbooks misrepresented the facts as if erroneous predictions were made first, to be followed by actual observations that resulted in a catastrophe, revealing the alleged inadequacy of 19th century physics, and then Planck (supposedly) made the discovery that

can be explained with the help of an idealized three-dimensional resonator.[78] In a cubic cavity with perfectly reflecting surfaces, electromagnetic waves can bounce indefinitely from one internal surface to another. When the path of a wave is closed on itself, a resonant pattern emerges. This is only possible if the length of the resonant path contains an integer number of wave-lengths (in the same way in which a guitar string can only resonate at predetermined tones and overtones, given its length). Still, the resonant paths can be oriented in all sorts of directions, which means that the length of resonant paths can take arbitrary values, within the limits that are dictated by the size of the cavity. As a result, the spectrum of possible resonant frequencies is continuous, but the number of non-identical instantiations of the same frequency varies. In fact, this number grows exponentially with the value of the frequency. Thus, high frequency modes are much more probable than low frequency modes. Moreover, their probability is so high that the likelihood of low frequency modes is vanishingly small. Note that there is no maximum value for the frequencies that are theoretically possible inside a cavity, as far as geometry is concerned. This means that there are an infinite number of possible resonant modes at very high frequencies, requiring an infinite amount of energy to fill them. Accordingly, resonant cavities should behave like black holes, absorbing all the energy of the Universe into high-frequency modes, with little or no energy at low-frequency modes. This is,

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produced the foundation for modern physics (http://en.wikipedia.org/wiki/Ultraviolet_catastrophe). Indeed, this is how I (*G.M.)* learned about this problem for the first time.

[78] In the real world, thermal equilibrium emerges after energy is absorbed and emitted by the walls of a cavity at the internal resonant modes of the substance that makes the walls. Regardless of the state of energy that is injected in the cavity, eventually it is going to contain a balanced black-body spectrum. Still, for the purpose of explaining the relevant statistics, one can ignore the physical aspect and focus only on the final state. It does not matter how energy gets to be in equilibrium, as long as the profile of that equilibrium is perfectly predicted by the number of resonant modes that are geometrically possible in a cavity. In short, we can ignore the fact of real porous cavities bounded by walls with resonating molecules and imagine a cavity with perfectly reflecting walls in which energy settles into available resonant modes instantaneously. It is as if we were reversing the role of the cavity with that of the resonating molecules.

indeed, a catastrophic implication in obvious contradiction with our observations. There is more than one cavity in the Universe, and yet there is still a lot of energy available to make everything else possible. Moreover, energy is detectable at low frequencies up to maximally possible levels of intensity.

If excessive amounts of high frequency modes are not observed, there must be a natural law that prevents their manifestation, enabling instead the low frequency states of radiation. At first, the reasons for such a law did not seem clear, because it was already established that all resonant modes should have the same amount of energy in cavities with thermal equilibrium. For any type of cavity, the amount of energy in each mode was predetermined. It had to be constant and proportional to kT, which is the product of Boltzmann's constant and the value of the absolute temperature inside the cavity. What could possibly perturb the likelihood of some frequency modes, but not others, if all of them had to have the same amount of energy? In order to solve this problem, one must assume (along the lines of Planck's model) that resonant energy modes can only emerge in discrete packets. Moreover, the size of each packet had to be directly proportional with its carrier frequency, in order to fit the linearity of the Rayleigh-Jeans curve. If low frequencies had small wave-packets, then they required large numbers of them to fill a resonant mode (nkT). If high frequencies had large wave-packets, then they required small numbers of such units to fill a resonant mode. Moreover, if the wave-packets were proportional to frequency, then there had to be an upper limit where the size of the wave-packet exceeded the value of nkT. This means that very high frequency modes would only be physically possible at very high absolute temperatures. Thus, if energy cannot exist except in well-defined wave-packets, then low energy wave packets are more

probable than high energy wave-packets. They are possible in greater number per modes, and they also take less time to develop. The low probability of high-frequency wave-packets erases the high-probability of high-frequency modes, because the wave-packets had to be possible before they could fill the modes. Accordingly, the low-frequency modes are always likely to be filled up to a certain frequency, as dictated by the absolute temperature of the cavity. After that peak, the high-frequency modes should diminish in number, resulting in decreasing intensity, down to zero for cut-off frequencies. Planck's insight was astonishingly powerful, because it could be used to predict the shape of the spectrum for any temperature of a resonant cavity, as well as the overall shape of the Rayleigh-Jeans curve. Therefore, the analysis of these ideal-type cavities enables the proper prediction of the spectrum of black-body radiation for real substances.

As mentioned above, Planck did not develop his model to address the "ultraviolet catastrophe". He invoked quantization as just a mathematical tool that was needed to reach a better prediction. Given his apparent belief in the wave nature of energy, Planck did not seem to like the concept of particle-like blobs that were inspired by his conclusions. In other words, he seemed to favor a model in which quantization is merely a feature of the means of detection, without implications for the actual states of energy at emission. Nevertheless, the ultraviolet catastrophe is a strong argument in favor of the reality of quanta. The probability of each frequency mode in a cavity is not dictated by external factors. Any input mixture of energy ends up with the same output balanced spectrum. Therefore, it has to be the case that energy cannot resonate at high frequencies, except when there is enough of it to constitute whole wave-packets for each frequency mode. Such a property cannot be just an effect of the cavity on otherwise continuous

energy. The cavity may determine which frequencies are more likely, but it cannot determine whether resonant modes are filled by discrete or continuous entities. Thus, energy has to be quantized whether it is a wave-packet or a particle. Note that the energy of a wave is equal to the product of frequency and amplitude. A fixed value for Planck's constant implies that radiation could not occur except at fixed amplitude values (with integer multiples of the constant). This is such an unusual constraint for a wave model that it simply cries out for an explanation. Einstein's photon hypothesis probably seemed more intuitive, because a particle is easier to imagine with discrete boundaries. If energy was fundamentally quantized, then it had to be the case that it could only exist in the form of discrete bits that are proportional to Planck's constant. Still, the frequency of energy could take any value, which means that the size of quanta could vary continuously. Hence, it just had to be the case that energy only comes in discrete bits, and bigger bits should be described as having a higher frequency, somewhat conventionally. Moreover, those energy particles had to be massless, and also behave like waves in many contexts. This is very hard to explain qualitatively, especially because the frequency of photons was not exactly a conventional attribute. It had a precise physical function, since electromagnetic waves do oscillate with well-defined frequencies. Furthermore, it is the analysis of resonant cavities that justified the hypothesis of quantization in this case, and the length of each path for any given frequency mode demanded precise correspondence in terms of radiation wave-length. From an interpretive point of view, the hypothesis of real photons (defined as particles) creates just as many problems as it solves.

Both Planck and Einstein referred to quanta of energy in terms of large units (be it wave-packets, or particles). In other words, discreteness was supposed to be fundamental

at the level of photons. If these bits of energy were not possible in fractional sizes, then it had to be the case that photons are indivisible. The problem is that photons are not entirely like that. They do exist at stable energy levels, but their frequency can be increased (up-conversion) or decreased (down-conversion) in special contexts (e.g., by interacting with a charge). In fact, the emergence of the black-body spectrum during thermal equilibrium depends on this feature[79]. Moreover, the size of a photon is not restricted by any consideration, as mentioned above. Photons could contain arbitrary amounts of energy, because frequency values have no restrictions. It is only for photons with a fixed frequency that energy is restricted to integer multiples of Planck's constant. The physical property that corresponds to Planck's constant is *action*. Frequency, of course, describes the number of repetitions of units of action per unit of time, and energy is the product of both action and frequency. Considering that all frequencies contain the same unit of action, and that all frequencies describe nothing but the number of units of action per unit of time, it follows that the only truly indivisible constituent of energy is Planck's constant. This is the essential bit that energy is made of; it has to add up to constitute frequencies; and finally photons cannot exist except as integer multiples of this unit for all cycles of energy waves. To sum up, the motivation to obtain indivisible large units of energy (photons) produced a valid model in which only the elementary unit of action is actually indivisible in a meaningful way. Moreover, it is not immediately clear how to get from indivisible units to macroscopic quanta, as far as the underlying mechanics is concerned. Without additional assumptions, it is not possible to explain why the constituents of a particle should have just one size (without being further divisible), in

[79] This comment is not meant to question the discontinuous nature of single photons. Rather, it is intended to suggest that wave-packets are like molecules, whose discreteness emerges from the discrete nature of their fundamental constituents.

the same way in which it is not possible to restrict the amplitude of simple waves to discrete amplitude values. In contrast, the same process can be given a natural interpretation in terms of propagating sources of waves. Assuming the existence of a large number of identical elementary oscillators, with constant parameters of motion, the energy of their waves has to be imparted to stationary detectors in the form of oscillations too. One source passing by produces one cycle, which means that the frequency of the electromagnetic waves can be determined by the number of sources that pass by. If so, one cannot have any given frequency without a corresponding number of sources. Given the assumption that all sources are identical, their action per unit of time must also be identical. The energy of any wave-packet would have to be equal to the number of sources multiplied by the action of each source. If so, then it is no longer a mystery why photons should have discrete amounts of energy. In fact, any observational deviation from the assumption of quantization would seem anomalous.

According to this new model of energy, the photon is neither a particle, nor a simple wave. It is better visualized as a train of sub-quantum sources of waves. During any unit of time, a fixed segment of such a train would pass by a stationary detector. Given that the speed of the sources is equal to the speed of light, the segment should have the same length for all frequencies, but the density of sources should be different. Accordingly, the energy of a photon is not supposed to be concentrated in a spherical blob. A photon is described here as just a segment of a long pulse. This can explain why electromagnetic waves have particle-like properties that are not fully similar to those of massive particles (fermions). Photons are bosons, which means that they behave collectively like fields; and yet they have particle-like properties because they impart

their energy in small regions of the transverse plane to their direction of propagation. This model can be shown to accommodate many interpretive concerns in quantum mechanics, and extensive details in this regard were presented elsewhere[80]. However, it does not come without a price. The most important qualitative implication is that the Universe must be an open system, with regard to energy. In contrast to current approaches, which assume that energy is conserved because nothing comes in and out of the Universe, the postulation of sources implies that energy must be constant because the number of sources is constant. The only form of energy is wave energy, and it is steady in any finite region surrounding a source, because it propagates out (at the edges) at the same rate at which it is produced (in the center). Another interesting consequence of this model is the fact that energy is an inseparable property of matter. This means that molecules move faster at higher temperatures because they are packed with more sources of waves. Average molecular speed correlates with temperature variation, but only as a consequence of the stipulated process. It cannot be a cause, and this is why it is possible to give an intuitive mechanical interpretation to this process. Entropy must also be described as a consequence of the action of elementary sources, without being a metaphysical cause. In other words, local violations of energy conservation must be impossible, and not just improbable. As shown above, the actual existence of elementary sources is verifiable, because the speed of the waves can be measured experimentally. It is supposed to correspond to the speed of propagation of changes in static fields. In conclusion, the assumption of propagating sources of waves is not just compatible with

[80] G. Mardari, "What is a photon?" in *Proc. SPIE,* vol. 6664, p. 66640X (2007) and "What is a quantum really like?" in *AIP Proc*., vol. 810, p. 360 (2006).

current scientific knowledge. It can even lead to new solutions for outstanding interpretive problems in physics.

From a philosophical point of view, it is an important accomplishment to prove compatibility between the preconditions for freedom and the physical properties of the Universe. This means that the observable world is authentic for the development of rational self-consciousness and that human choices in this world are relevant in a fundamental sense. Nevertheless, these conclusions are insufficient for an impact on the society at large, which is the primary concern of this dissertation. For such an effect, this new interpretation of the Universe must become the mainstream approach in science. In the language of Kuhn's theory about progress in history,[81] there should be a set of open problems in science whose resolution would not be satisfactory without a paradigmatic shift, preferably inspired by the concepts of the proposed model. Accordingly, the addendum to this chapter is going to be devoted to the analysis of several pertinent problems in different areas of research. A reinterpretation of the fundamental properties of matter cannot go far without new implications for large classes of phenomena. The task is to establish if these implications are helpful for the resolution of known puzzles in theoretical physics and to identify the kind of efforts that would be necessary for definitive answers. Wherever this new model has clear observational repercussions, experimental work should be possible for verification. With this in mind, the task of the presented analysis is not to give any sort of conclusive answers to outstanding problems in science. Rather, it is to provide methodological recommendations that could be useful

[81] T. Kuhn, *The Structure of Scientific Revolutions* (U. Chicago Press, 1996).

for the goal of testing the specified theoretical proposal (in the short run), as well as to evaluate its social relevance (in the long run).

Summary and conclusions

In a previous chapter of this dissertation, it was shown that rational self-conscious beings can emerge in lawful material environments. The operation of free will in such contexts becomes a verifiable hypothesis, because it depends on the fulfillment of several physical preconditions. Accordingly, the present chapter was motivated by two goals. One was to determine if there are theoretical reasons to expect the specified properties to be real. The other was to identify the most likely sources of knowledge that could inform their public acceptance as a matter of fact. Thus, the foregoing text was centered on the possible reasons to believe that our Universe contains a fundamental level of material organization, with elementary entities that engage in mediated interactions.

This first priority of this work is to provide methodological, rather than substantial answers. The search for definitive conclusions is expected to be more efficient, if speculation is separated from fact. Hence, the investigation was informed by strategic concerns, such as: where to look for answers, and what would it take to make those answers possible? Nevertheless, in some cases it is difficult to separate the method from the answer. One might even suggest that sometimes the method *is* the answer. Indeed, this is what was shown for the problem of structural organization of matter in the Universe. It is impossible to know for sure if the Universe has a fundamental level with indivisible entities and indestructible motion. All sorts of arguments are plausible, and no way to "see" the truth is available. On the other hand, if the focus is shifted from "What

is the ultimate Nature of the Universe?" to "How much can I know about the Universe?", then manageable answers become possible. Moreover, these are the answers that are truly relevant for immersed observers, given the limitations that were explained in the philosophical part of this thesis.

When it comes to the organization of matter in the Universe, the problem is to determine how it might affect the means of investigation that are available for rational beings. This is the motivation for shifting the focus from actual qualities to functional relationships. Is the Universe infinitely reducible to lower and lower structural levels, or does it have a special process that can put an end to all further efforts at reductionism? The latter option implies that a material context might have a methodologically fundamental level of organization, whether or not this is the actual basis for everything (as seen with a God's eye view). By implication, a phenomenological description of such a Universe must include a fundamental level of organization, serving as a boundary between internal (physical) and external (metaphysical) processes. It is this physical limit that matters for the discussion of free will, and all relevant consequences. Moreover, it can only be compatible with a limited number of well-defined and verifiable configurations of material properties. These qualities can be derived from the requirement of theory-independent constant parameters for elementary entities and their motion, because they serve as objective reasons for any hypothetical limit for reductionism. This line of reasoning suggests that our Universe is compatible with a description that assumes the reality of a methodologically fundamental level of material organization. The interpretive gap between quantum and classical processes, the quantization of energy, the

invariant speed of light, the possibility to explain all physical interactions in terms of identical elementary entities – all support the specified conclusion.

The second material precondition for the exercise of free will is the existence of an all-pervasive physical medium. Its function is to support the propagation of waves that mediate interactions among elementary entities. Such a property is excluded from consideration in many modern interpretations, but the experimental basis for this position is weak. The strongest empirical argument against a universal medium is provided by the observations of Michelson and Morley, who proved the invariance of the speed of light. If light was a classical wave, its speed was expected to vary with the direction of propagation, as observed for all other propagating oscillatory phenomena. However, many properties of light are explained with greater convenience in terms of particles. If light displays wave-like and particle-like properties in different contexts, it is quite possible that its speed is determined by the particulate aspect. Incidentally, the preconditions for freedom demand a description of electromagnetic radiation in terms of propagating sources of waves. This implies that the speed of light is not the speed of a wave. The collective behavior of elementary constituents of light must be influenced by the secondary waves produced by them, whose speed has yet to be determined.

Given the insufficient experimental basis for rejecting the hypothesis of mediation, methodological issues emerge to the forefront of the discussion. Is it the case that such an assumption would complicate the interpretation of physical processes? If it required extraordinary properties that were not seen in other media, then it would have to be discarded in conformity to Ockham's razor. Yet, this is not the case. The invariant speed of light does not imply that the universal medium contains invariant waves. Even if

it did, this property would not be exceptional. As shown in a quoted paper by Barceló and Jannes, complete observational immersion can produce the appearance of invariance in any classical medium. Therefore, the hypothesis of mediation is still compatible with existing knowledge about our Universe. Nevertheless, it is relevant to know if it is possible to verify it in a conclusive manner. Ideally, it should be possible to identify a phenomenon that could serve as a reliable indicator for the hypothetical medium, in the same way in which the predictions of Michelson and Morley were expected to be. This problem was solved by showing that static fields can be interpreted in terms of physical models involving underlying running waves. If light is truly made of propagating sources of secondary waves, then internal changes in the profiles of electrostatic and magnetic fields should propagate with a finite speed that is not necessarily equal to the speed of light, and probably higher. This is a novel phenomenon that is not anticipated by existing formal models, but it is verifiable with modern experimental tools.

The third discussed precondition for freedom is the existence of elementary identical sources of wave, whose patterns of motion and interaction should determine the properties of all physical processes. If such sources existed, all the energy in the Universe should be in the form of quantized wave energy, with indivisible units of action. Such a description is quite compatible with the current state of understanding in physics, in which Planck's constant plays a very important role. Historically, Max Planck proposed the concept of quantization as an *ad hoc* tool to fix a gap in the statistical models for the black-body radiation. He was interested in the probability of emergence for large wave-packets of energy, corresponding to resonant modes in three-dimensional cavities. Accordingly, the constant that bears his name ($\hbar$) was introduced to ensure

proportionality between relevant parameters, as an analytical element. Albert Einstein took the next step to assume that Planck's wave-packets must correspond to real particulate constituents of electromagnetic radiation – the photons. These entities were supposed to be indivisible, which left the physical essence of $\hbar$ unexplained again (as it remained since). The tone of the presented argument is set by the attitude that Planck did not go far enough with his analysis, whereas Einstein went to far. Quantization seems to be artificial in both of these approaches, creating interpretive difficulties. In contrast, the assumption that $\hbar$ truly corresponds to an indivisible unit of action enables a meaningful interpretation of the formal models that predict the well known manifestations of energy. This conclusion enables an intuitive explanation of the physics behind the relevant statistical processes, suggesting that the Universe does not have to be fundamentally probabilistic. As a result, there are sufficient reasons to believe that the interpretive contradictions between the first two laws of thermodynamics can be removed, in addition to the deduction that our Universe is compatible with the exercise of free will.

The three described preconditions for freedom have clear experimental implications. Because of this, the discussion can progress from the grounds for theoretical compatibility to the most likely opportunities for actual validation. Most of the indicators for this new model are compatible with existing observations, but this puts it in competition with several other models that are already well established. That is why it is more expedient to focus on recent observations that are not yet fully understood, whose interpretation might benefit from the presented approach, and even on proposals that have not yet been tested at all. It is, therefore, important, to encourage further research on these topics in physics.

V. GLOBAL CULTURE FOR THE GLOBAL VILLAGE

Abstract: This final chapter summarizes the main conclusions of the dissertation and elaborates on their minimal and maximal social implications. The possibility of a teleological model of social progress, with a corresponding theory of social change, is discussed.

In search of Enlightenment

Modern liberal democracy is centered on the rights of the individual and the protection of private property. This emphasis on personal freedom and safety has important advantages, as it leads to social environments in which people can manifest their creativity and take risks in pursuit of their goals. In the long run, this can enable social progress and economic growth, provided that healthy governments can ensure the rule of law. In a way, democracy seems to rule by not ruling. The golden tenet is to allow the people to follow their dreams, because the "invisible hand" can take care of the rest. At least, this is how the myth of the American success appears to be promoted in other parts of the world. The actual reality is more complex, as usual, and quite often the model does not work as expected. Economic inequalities translate into asymmetric relationships among private interests. On the one hand, this has a troublesome impact on society, because it is possible for powerful minorities to override the interests of the majority. On the other hands, this leads to even more dangerous confrontations between powerful interest groups competing for the same resource, be it material or spiritual. In short, democracy ends up being perverted, apparently by adherence to its main virtues.

It might be tempting to decide that democracy is fundamentally flawed, or at least its mechanistic version of laissez-faire liberalism. A better stance is to treat this simply as a perverted understanding of democracy. The crucial importance of individual rights and private property is diminished by the attempt to justify them in terms of material benefits. This even makes them vulnerable to loss of legitimacy, when compared to other ideal types of governance (for example, enlightened despotism), if it could be argued that those are more efficient. Worst of all, this approach strips democracy of the truly revolutionary aspect that led to its adoption, starting a few centuries ago. The greatest political problem of the pre-modern world was legal inequality. Small groups of people were allowed to claim special entitlements, relative to all other people, and the abuse that followed was unbounded. "Power tends to corrupt, and absolute power corrupts absolutely"[82]. The crucial effect of Enlightenment was to transform the idea of equality for all into a primary social principle, presenting it as an indisputable dictate of reason. It is this universal value that justified the development of institutions for the protection of individual rights and liberties. And, somehow, it is also this foundational element of democracy that was replaced by economic functional reasons over time. The outcome is a state of tension inside developed democracies, as well a growing risk of international violence. The driving forces of globalization have pushed this version of democracy to all parts of the world, becoming entangled in its unavoidable consequences. Thus, the problems of globalization and the problems of democratic theory are deeply connected. If the foundations of democracy are not strengthened, it cannot develop harmoniously, and the prospects of peaceful globalization in its spirit become questionable.

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[82] This is a quotation from Lord Acton (John Emerich Edward Dalberg), in a letter to Bishop Mandell Creighton, 1887.

The first step towards fixing this problem is to understand the origins of modern democracy. Enlightenment would have been worthless, if its only goal was to shift entitlements from one group of people to another. Reducing it to an institution for popularly voted (but still unfair) distribution of privileges is not much better. Enlightenment is above all a moral standard, based on dispassionate reason, which restores the dignity of every individual, by giving each of them the same chance at self-realization. In a way, it aims to transform the whole of humanity into a family, in which brothers and sisters can trust each other, knowing that nobody would want to take advantage of their confidence. This aspect of Enlightenment is similar to the universal motivations of some religions, except that it includes all the people and refuses to treat any of them as means to some end. Moreover, it promises to make human existence truly meaningful, by invoking reasonable principles for social interaction, whose foundation is intelligible to all. This model is obviously idealistic, but it is still credible, because it does not promise instant gratification. It offers a method for continuous social improvement through public deliberation. Granted, the ideology cannot work without appropriate institutions, but the latter cannot succeed on their own either. Hence, it should not be surprising that commercial democracy leads to injustice and violence. Without the spirit of Enlightenment, democracy cannot fulfill its purpose.

This conclusion leads to an intriguing hypothesis: without adherence to the universal values of Enlightenment, globalization cannot be peaceful. It might seem appropriate to debate whether such adherence is possible at all. Yet, the problem of interest for this study lies elsewhere. As hinted in the introductory chapter, the ideology of Enlightenment cannot take root in the modern world. This curious statement can be

given a stronger justification with the following argument in seven steps. Firstly, it should be noted that Enlightenment entails a full commitment to rationality. Its success depends on the willingness of the people to adopt the products of dispassionate reason as the guiding values for their actions, even if (and especially when) rational conclusions contradict previously entrenched prejudices and intuitions. If not, unfair traditions and practices cannot be eradicated. Secondly, Enlightenment depends on the exclusive authority of science on matters of knowledge. All the facts that are accepted as true must be produced according to the same principles of objective and evidence-based methodology. Tradition and authority must give way to justified grounds for any belief. Thirdly (on the other hand) the exercise of rationality must be carried out by rational beings, and must only work within the limitations that apply to such agents. Rationality does not happen magically. It has to be exercised by human beings who are neither omnipotent nor omniscient, and who can only carry out deliberate actions to the extent to which the latter can be meaningful for them. Agents can only do what they are able to do.

The fourth step is to invoke the fact that rational beings are "hardwired" to expect a unified interpretation for the totality of knowledge available at any and all times. This insight was made famous by T. Kuhn, who showed that meaningful research questions cannot be formulated in the absence of a pre-existent framework for analysis. Moreover, it was also shown above (in Chapter II) to work as an intuitive predisposition for any rational being, derived from the synthetic a priori conditions for the operation of rational self-consciousness. The importance of this property will become clear after the fifth step, which is an empirical statement. Namely, it happens to be a feature of our Universe that macroscopic physical processes can be sufficiently described in terms of material

determinism. If metaphysics is superfluous as an explanatory variable, then it is irrelevant as an ontological process, according to the principles of scientific acquisition of knowledge. Any (provisional) unified theory of scientific knowledge must be consistent with such conclusions. In other words, rational investigators of the Universe cannot help but conclude that physical laws are sufficient to account for every possible phenomenon and experience. If so, then contrary intuitions must be described as illusory.

The sixth step of this argument is to restate the necessity of synthetic a priori properties for rationally self-conscious beings. A rational being cannot believe that such conditions are not fulfilled, without also thinking that its own existence is illusory. The list of such preconditions includes the possibility of free will and the possibility to explain the world with a single set of principles. Both of these preconditions are ruled out by the adopted interpretations in modern physics. This makes the validity of rationality irrelevant. Yet, a being cannot exercise its agency without the implicit assumption of its own existence. Ergo (step seven), commitment to Enlightenment forces the conclusion that rationality is self-refuting, given the current state of knowledge about Nature. By implication, the conclusions of scientific studies must be bracketed and used only as practical tools. The foundations for human agency must be understood on the basis of alternative intuitive dispositions (both acquired and pre-existent).

As a consequence of the above, Enlightenment cannot succeed as a project (even in the absence of other practical concerns), until this contradiction is removed. The best way to study and interpret the experienced world, according to the fundamental principles of Enlightenment, is through the exercise of reason. Clearly, this cannot work, if reason entails the invalidity of personal experiences. Serious commitment to rationality is

problematic, and therefore it cannot become a mandatory principle that governs social processes[83]. This can be understood as a choice between two types of moral systems: one of them is based on the intuitive appeal of mythical concepts and principles, while the other is based on the intuitive appeal of rationality. If scientific theories undercut the validity of pro-rational intuitions, only the traditional types of rationality become socially relevant. Modern communities end up being deprived of the tools that could be used to oppose religious fundamentalism, ethno-nationalist extremism, racism, etc. The use of reason in the public domain becomes optional, as it can only be based on blind faith. Though, even this blindness cannot be sustainable, when the problems of the day are presented with ever increasing virulence, through more and more invasive informational technologies. A possible strategy would be to "convince" the people that foundational problems do not matter so much, compared to the practical results of science. Yet, this would not be a step towards Enlightenment.

The way out of this conundrum can be found by re-examining steps three and four. It is natural for rational beings to generalize their paradigms, but it is just as natural for the paradigms to change, when so dictated by new discoveries. As far as physical phenomena are concerned, macroscopic processes are well understood by now. Significant and fundamental changes in their interpretations cannot be reasonably expected. In contrast, the study of microscopic material processes is still a work in progress, given that several theories are competing with each other, without being able to yield a complete model of Nature. This means that new discoveries are still possible (and necessary), if the trend of scientific progress continues. With unexpected knowledge, new

[83] A typical objection can be formulated like this: "Why should we put our faith in the independent powers of reason, if it is self-refuting?"

theories must replace the old ones. For all we know, the scientific models of the future might lead to paradigms that do not contradict their own foundations. The work of science is not over yet, and it is too soon to make final statements about its final implications, especially with regard to the place of rational beings in the Universe. Accordingly, the hopes of restoring the status of Enlightenment must rest on the likelihood of appropriate developments in the study of microscopic physical phenomena. With that in mind, let us re-evaluate the main conclusions of this dissertation.

"Appropriate changes" in the content of modern theories refers to the possibility of accommodating objective and subjective observations about the world. In other words, the mental faculties of rational beings must work as demonstrable outcomes of physical processes, without being described as illusory or false. Instead of guessing about the kind of facts that might work for this endeavor, it is better to derive them logically from the known properties of rational beings. This is why it was crucial to begin with the reverse engineering of rational self-consciousness, building on Kant's approach to the more general concept of consciousness. Important general properties were derived in Chapter II, and more specific physical manifestations were worked out in Chapter III. Finally, Chapter IV demonstrated the compatibility between existing facts and derived properties. The strongest claim of this dissertation is that no physical fact is known to refute the true possibility of rationally self-conscious beings in our Universe. Logically speaking, such facts might still be discovered in the future (especially if it is possible for physical laws to contradict each other – a very unlikely discovery, given the existing historical record). However, the stated problem was that *current* scientific paradigms refute the validity of necessary human intuitions about existence, on the basis of *already established* facts. If it

is possible for future developments to absolve scientific observations from the guilt of refuting scientific rationality, then Enlightenment is still a viable alternative for social progress, and peaceful globalization is still a real possibility.

The end of history?

The next problem is to justify the vision that connects theory to practice and hopes to reality. Why should anyone expect this "possibility" to materialize itself? The answer follows from the details of the main argument of this dissertation. Yet, a disclaimer should be made at this point. The following comments are based on the assumption that human beings are not wrong about their own existence[84]. If human beings truly are rational agents, then the preconditions for their evolution as such have been fulfilled. It is possible for several kinds of initial properties to lead to the emergence of rational self-consciousness, but this dissertation has considered only one. What was actually shown is that at least one scenario is compatible with existing physical facts, and that was sufficient to refute the incompatibility between human knowledge and intuitions. Yet, this is not *just* a scenario. It is a model for the best possible design of the world, in which the fundamental questions about existence have verifiable answers for its rational inhabitants. This leads to two questions. Number one: do we live in such a world? Number two: what follows if we do?

Various epistemological issues prevent us from ever being sure about the fundamental nature of our surroundings. Technically speaking, the first question cannot

[84] They could be wrong, for all we know, but then democracy and Enlightenment would be the least of their worries.

be answered literally ("Yes, we live in that world"), but a softer version of the answer is possible (such as, "Yes, we live in a world like that"). Note that all the known facts are already consistent with this possibility. However, there are untested properties that could still go either way: for or against the hypothesis. The most important one concerns the stipulated existence of elementary entities that act as sources of waves. In other words, quanta must be made out of identical sub-quantum entities of that sort. As explained in the text, this property can be verified by testing the speed of propagation of changes in fundamental static fields. In plain language, the speed of magnetic pulses must propagate in violation of the so-called Einstein causality. They might have superluminal speeds, and they must violate the principle of invariance (unlike the speed of light, which must obey it). If this phenomenon were to be confirmed, then the answer to the first foregoing question would have to affirmative.

Now, let us focus on the second question. Suppose that requisite experiments are performed and the stipulated property is confirmed. As argued in the text (and especially in the Addendum to Chapter IV), multiple phenomena support this expectation. In fact, it would take a contradiction in the existing experimental record for this prediction to be wrong. Still, it is not immediately clear that such a discovery would change much. One might say: so what if we have one more phenomenon in favor of the stated assumption? In order to get to an answer, one has to consider the practical implications of this hypothesis. First of all, as suggested above, the principle of Einstein causality will be violated. Secondly, and more importantly, the 19th century hypothesis of mediation would have to be revived. Thirdly, the concept of energy will have to be reinterpreted, as well as the underlying causal mechanisms for its manifestation. It does not take a degree in

science to realize that such a set of implications cannot be accommodated by existing models in physics. If it is empirical data that calls those models into question, several consequences must follow. The formalism of quantum mechanics will no doubt maintain its validity, but the Copenhagen interpretation would have to be discarded as an ontological model of reality[85]. The theory of relativity will maintain its predictive power, but its status as a faithful ontological description of space-time will have to change. Furthermore, the long run implication of such a discovery would be the demonstration that some processes inside our Universe can only be explained by reference to external causes. It will be possible to define an entire class of physical events that could not possibly be predicted by the physical models. In short, this phenomenon cannot be discovered without causing a paradigm shift in modern science.

The ramifications of such a discovery would have to spill into the field of philosophy as well. The relevant prediction was made on the basis of several philosophical arguments. If the phenomenon is confirmed, the reasons for its derivation will have to influence the topics of discussion in the corresponding fields of study. In the domain of epistemology, the problems of radical skepticism would have to be reconsidered, given the proposed shift from absolute reality to authentic reality, as a relevant concern for rational agents. This would have to be a positive development, as it has the potential to strengthen the foundations of science, with particular emphasis on the credibility of observed facts. With regard to the philosophy of mind, new developments will have to follow from the insights on the interaction between mind and matter, especially as part of the mechanism for free will that was used to make the physical

[85] There is an important difference between the ability to predict the outcomes of unobservable processes and the ability to describe them as they truly are. More often than not, interpretive models are designed to fit the properties of the formalism, rather than the properties of Nature.

predictions in question. Remarkable developments are likely to follow in the philosophy of physics as well, especially with regard to the concept of determinism. At the moment, it is widely believed that all physical phenomena have purely physical causes (internal to the Universe) and that all future physical events are reducible to already existing physical facts and laws. If the current scientific paradigms are revised, as suggested above, it will follow that physical laws must work without exception, without being sufficient to explain the totality of physical manifestations. In other words, determinism would have to include the possibility of non-physical causes that do not contradict the operation of physical laws. The net effect of these developments in science and philosophy would be a consensus on the conclusion that objective knowledge and subjective expectations about the world are fundamentally compatible with each other.

To sum up, it is possible that static fields have the relevant properties for the real operation of rational self-consciousness. If these qualities are confirmed, unavoidable theoretical implications would follow, making Enlightenment possible again. Moreover, rationality would have a strong factual support that was merely assumed to be possible in the 18th century. As far as foundations are concerned, the problem would be solved. But why should we expect this to have any real impact on social processes? A minimalist answer would be that (at least) some people would benefit from these developments. For example, those who care about explicit arguments regarding truth and existence, and especially those who feel that fundamental worldviews are a matter of choice. Another possible argument is that extremist propaganda requires an environment with low tolerance for reasonable counter-arguments. As suggested above, cultural fundamentalism is fomented by the current interpretive crisis in science. Solving this

basic problem would lead to stronger general faith in the powers of reason, and diminish the appeal of retrogressive ideologies to the masses. Still, none of these explanations are particularly inspiring. It is, of course, important that major theoretical obstacles can be removed. However, global transformations require a stronger message, if not a teleological model. One needs to have a vision, in order to move the masses. It should be possible to turn this into something about human nature, and not just Nature. Perhaps, a proper answer to these concerns deserves more space than can be afforded here[86]. Nevertheless, several general remarks can be made in this context too, in order to convey a better idea about the maximal possible impact of the presented conclusions.

The philosophical findings of this thesis have several ramifications, but only one line of reasoning was investigated, in order to satisfy the concerns about physical observations. Though, a different chain of arguments can be shown to lead to a novel theory about cultural paradigms and their proliferation across generations. It is in light of this parallel analysis that the conclusions of this dissertation acquire a special importance. The main idea is that rational self-consciousness is a major factor in the process of adoption and sustenance of cultural systems. To be specific, it determines their purpose as a mediator between inborn predispositions and acquired knowledge. Continuous discovery of new facts reflects on the content of cultural beliefs, and leads to their gradual change. Yet, this process has been disrupted by recent developments. In the modern world there is a mismatch between traditional cultural paradigms and scientific knowledge. One might even argue that many cultural systems are only hanging on because of the mentioned foundational problems of science. Ergo, the demonstrated

[86] This is, indeed, a topic for a separate dissertation.

congruence between existing and expected physical properties is not “just another finding”. It could have tremendous social repercussions, in the long run. The reasons for that will be explained below.

It is frequently difficult to reconcile the description of humans as rational beings with the types of cultural practices that they sometimes endorse. Surprisingly, there is a rational foundation for this fact. This can be explained in terms of already existing social theories, and an exercise in this direction is presented in the addendum to this chapter. However, the concepts of this thesis provide an interpretive advantage. Self-conscious beings cannot be rationally aware of their existence without a set of intuitive pre-judgments, as explained. They cannot help but expect the world to behave in a certain way. Yet, their actual knowledge about the world must be acquired over time, starting from a clean slate. Moreover, objective limitations ensure that human observations are always partial, with few obvious connections between the facts. In order to navigate the known world with some kind of purpose and efficiency, it is necessary to understand how the facts are related to each other, and how they correspond to the (pre-given) intuitive principles. Some kind of agency needs to intervene, in order to provide a sense of unity to the mind of the rational agent, by mediating between knowledge and intuitions. Thus, cultural paradigms operate in the same way as scientific paradigms. The difference is that they aim to explain the totality of the world from a very limited (and sometimes controlled) knowledge base. The paradox is that highly non-rational modes of reasoning can inform the behavior of rational beings, once they become integral to their understanding of themselves in the world.

From a practical point of view, a rational being does not need to know everything in the Universe. It is only essential to trace a horizon that encompasses the totality of relevant experiences for a lifetime. The agent must acquire a sense of fitness to the realm of actually observable phenomena. Given the necessarily poor levels of knowledge at a young age, the formative stage must be a period of wonderment, when knowledge is gathered until such a horizon is defined. While this is going on, concerns about purpose and identity must play a secondary role. Yet, when the main parameters of the environment become sufficiently understood, a cultural paradigm must be adopted. Acceptance of the most meaningful paradigm is the norm, and usually that refers to the paradigm that structured the process of development. Though, social progress entails the discovery of new facts, and every generation has to leave its imprint on the content of the paradigm that becomes its own. The important factor is that adult agents have a sense of understanding of the world, which is normally set for life. The older a person becomes, the stronger the acquired sense of identity. Hence, even in the face of clearly contradicting evidence, fundamental beliefs may persist unchanged in the minds of rational beings. To denounce the values that define the identity is to deny the self. So, even if radically novel ideas can be understood in logical terms, they may not make intuitive sense. This means that cultural systems cannot be replaced by persuading the people to switch beliefs. They can only be subverted in time, if new members of the society subscribe consistently to some alternative paradigm. Essentially, cultures die if they fail to cross generational lines.

According to this description, knowledge growth must lead to cultural change. Yet, there is an obvious exception to this principle in the fact that most cultural systems

of the modern world perpetuate pre-scientific values and beliefs. Even without such a theory of cultural progress, it is quite startling that we live in a world so thoroughly dominated by science and so deeply divided on the matter of the validity of scientific facts. On closer inspection, this problem does not contradict the outlined mechanism. Rather, it is explained by it. The function of cultural paradigms is to reconcile the content of knowledge with the content of intuitions. If scientific paradigms tend to contradict the necessary intuitions of rational beings, they cannot become cultural paradigms. Hence, alternative belief systems must fill the gap, but they cannot do so completely, because they contradict too many observations. For this reason, traditional cultural systems need to encourage skepticism towards scientific facts. Even so, they cannot win enough supporters, and societies become polarized.

What if the foundational problems of science were solved and its models became able to inform the establishment of appropriate cultural paradigms? According to the conclusions of this thesis, nothing would change immediately. Most people would go on believing what they always did. However, the schoolchildren of today would grow up learning scientific facts without having to worry about any kind of conceptual contradictions with regard to their existence. When they reach maturity, they will not be able to award primary importance to the myths of their parents. Those ideas will not make sense to them, despite the social pressures to the contrary. Note that modern societies cannot afford to hinder scientific education, because of the highly technological nature of modern economic systems. If students are allowed to study in school and to express their feelings about what makes more sense, they would rebel against any conceptual imposition that contradicts their knowledge. This tendency to rebel is present

at all times, but it does not lead to social change in the absence of meaningful alternatives. If a new cultural paradigm were to emerge, on the basis of scientific facts, it would channel that rebellious spirit away from the status-quo. The simple reason is that old paradigms would no longer serve any deeply felt purpose.

Another factor to consider is that existing cultural paradigms are at odds each other, in their imperfection. This leads to growing tension (as emphasized by the arguments in favor of the "clash of civilizations"). If young people are expected to make enormous sacrifices in favor of unattractive goals, their resistance can only increase. When it comes to matters of life and death, rational people need to believe that they gamble with their lives for something greater. Truth matters always, and in cases like this it can become the decisive legitimizing factor for any social movement. It would take enormously costly efforts to bend the beliefs of young people and to constrain their access to information, in order to maintain their dedication to old cultural systems. Yet, such efforts can only be self-refuting in the long run. They would limit the opportunities for economic growth; they would create social tensions in response to imposed limitations; all in a background of high interest for novel informational technologies. In short, this is a path that offers very few incentives for voluntary support. It can either lead to sudden upheavals, or to delayed but still inevitable change, because the quiet dissidents are bound to become the majority sooner or later. (Indeed, this is what happened to the defunct Soviet Block at the end of the 20th century).

In short, the cultural paradigms of today can ensure their continuity only by reformulating their basic claims, such as to incorporate scientific facts and principles. Note that necessary intuitions are universal for all rational beings (unlike contingent

elements of “common sense”). Scientific facts and theories are also equally valid for all rational beings. This means that all the cultural paradigms would have to agree with each other on fundamental concepts and principles, whenever they fit well with basic facts and intuitions. Current traditions will only be able to determine the secondary elements of local systems of beliefs. As far as primary concepts are concerned, there can be only one overarching paradigm for all the people. This could become a platform for true global communication and understanding, unlike anything predicted by the constructivist approach in social sciences. Consequently, the presented model of rational self-consciousness entails a teleological vision of social progress.

If rational beings are produced by evolution in their material contexts, then the physical reality is such that it can produce rationality. As shown in the dissertation, skeptical concerns do not apply to this scenario, once the relevant physical preconditions are confirmed by scientific means. A world like that can only be intelligible for its self-conscious inhabitants. If science keeps progressing, it has to arrive at a final paradigm, which describes Nature correctly. Such a theory would necessarily inform a set of concepts that mediate perfectly between the necessary intuitions and acquired knowledge. After all, both of these intellectual elements emerge from the same source. Furthermore, the discovery of such a model of Nature must lead, with necessity, to the emergence of a unified global cultural system. Remarkably, this development would not require any military effort to conquer the world, and therefore it can be peaceful. In other words, the world appears to be structured such as to enable the emergence of a single cultural paradigm, matching the process of economic globalization. This cannot be enough to put an end to all wars, but it makes it reasonable to expect the exclusion of culture as a source

of violence in the future. This conclusion may seem overly optimistic, but its validity rests on the discovery of appropriate physical facts. If it turns out that magnetic pulses propagate as predicted in the text of this dissertation, then it has to be true. The evolution of a unified cultural system can only be prevented if mankind is wiped out. As long as humanity exists, it has to progress towards that end.

Extraordinary claims require extraordinary proof, and these few paragraphs cannot be taken as sufficient arguments. As mentioned above, this topic is complex enough for a separate dissertation. Perhaps, it would not even be fair to present it as plausible without proof of extensive corroborative research. Though, it is still interesting as a provocative argument, and the link between premises and conclusions does look strong. In any case, the value of this teleological model should be judged independently from the rest of this dissertation, whose goal was to address the foundational problems of Enlightenment as a potential modern process. For now, it is even OK to treat this theoretical morsel as pure speculation. Its main function in this context is to merely expand the framework of consideration for the results of this thesis. If nothing else, it shows that a new line of inquiry was established, with several unexplored avenues. Political science can benefit from this research in more ways than one, though it is the practical implications that are the most exciting, should the described predictions be confirmed. After all, it is better to change the world than to talk about it.

Final summary

All competent human beings are rationally self-conscious beings, and that means that all of them share the same set of necessary intuitions, experienced as “common

sense". This is not meant to suggest that common sense is everywhere the same. Instead, it is intended to draw a line between contingent intuitions (which might be both inborn and socially constructed) and necessary intuitions. All purposeful thought requires rational self-consciousness, and the latter cannot emerge unless a set of environmental conditions are satisfied. Due to the nature of these factors and their interplay, rationally self-conscious agents must believe that they exist, but also that the world exists and that it is real. They must also expect all events to have causes, as well as to think that deductive reasoning is the only way to sort concepts out. Furthermore, they must believe that they have agent-causal free will, meaning that their minds are autonomous sources of voluntary effects on material entities, manifested in the controlled motion of their bodies. This list is not exhaustive, and it can even go beyond the synthetic a priori categories described by Kant. The problem is that the world, as experienced, may not conform to these intuitions. A rational being can experience all sorts of worlds (including dreams and hallucinations). However, the world must conform to these intuitions wherever rational self-consciousness can emerge. An agent will have the tendency to treat any experienced realm as real, but only some of them can be authentic, in the sense of allowing the fulfillment of rational goals through purposeful thought and meaningful actions. The most important conclusion is that authentic realms of existence can be validated from inside, by studying the observable phenomena and deducing the rules that govern them.

Necessary intuitions are inborn, but they can only manifest themselves after the acquisition of rational self-consciousness by an agent. It does not help to describe them as evolutionary effects, because their understanding cannot be enriched by tracing their developmental path. All rationally self-conscious beings must have the same necessary

intuitions, or else they cannot be rationally self-conscious. It would not matter how the ancestors may have developed until they acquired this faculty, because no other evolutionary path could produce rationally self-conscious beings without these intuitions. This point has to be emphasized, because of its methodological implications. The study of Nature often leads to observations that contradict existing theories. Sometimes it might seem easier to devise ad hoc explanations that contradict the necessary intuitions of rational agents. When this happens in modern physics, it is the intuitions that are accused of being faulty, because they could be simple evolutionary accidents, unrelated to the types of rules that govern the operation of Nature. This is even supported by well grounded claims that many scientific discoveries contradict the common sense, as it was the case, for example, with the idea that the Sun orbits the Earth, rather than vice versa. The proper response to this approach is to emphasize the existence of two kinds of intuitions, as part of the common sense. Necessary principles cannot be dismissed by facts in authentic realms of existence. If it was possible to prove that a phenomenon contradicts the necessary intuitions of rational beings, it would not follow that the intuitions are wrong. Instead, it is the nature of the world that must be questioned, for it would have to inauthentic. The existence of rational beings necessitates the existence of authentic realms, and each true agent must have one (and be able to "escape" to it).

As mentioned more than in once in the text of the dissertation, modern science is dominated by theories that contradict the necessary intuitions of rationally self-conscious beings. This implies that either the world, or its rational beings, is/are false. More importantly for political science, this is an obstacle for the progress of democracy, internally as well as externally. In the context of economic and informational

globalization, this is a big problem. It raises concerns about the sustainability of democratic political systems, and seems to aggravate intercultural relations. For reasons like this it was important to derive a standard for evaluating the relationship between scientific facts and necessary intuitions. The method of reverse-engineering of rational self-consciousness was applied, with special emphasis on the necessary conditions for the operation of free will. In the sphere of modern philosophy, free will is a debated concept, without consensus on the proper way to define it. Yet, these difficulties were circumvented by sticking to the properties that were consistent with the specified necessary intuitions. The outcome was a model in which deterministic laws were never contradicted, but determinism failed nonetheless, satisfying the main concerns of both major traditions on this issue. The goal of this project was achieved by deriving a minimal list of general physical preconditions for the emergence of rational self-consciousness. Those properties were shown to be verifiable and demonstrably compatible with the known facts of modern science. Therefore, existing physical observations do not contradict the necessary intuitions of rational beings. They are compatible with two kinds of theories, and future developments can tip the balance in favor of models that are compatible with human conceptual predispositions.

Science plays a central role in our world, directly as well as indirectly. Its practical accomplishments appear to eclipse its cultural implications. Yet, those material achievements perform a double duty: they satisfy pertinent needs, and also confirm the method that produced them. Liberal democratic societies derive their founding principles from the tradition of Enlightenment, which is nothing less than an extension of the scientific method into the realm of political affairs. Those principles require authoritative

justification, especially when they confront opposing values. They must be shown to lead to truth, and science offers living proof of that potential. For the continued progress of democracy, science must not fail to work, nor should it undermine its method. But what can be done if science denies the intuitive principles that set it in motion? No doubt, it can still keep growing, but the toll for this shortcut is collected in the social sphere. Short term efficiency becomes the only legitimate value, and scientific rationality is replaced by anachronistic modes of reasoning in the public sphere. By consequence, economic globalization is taking place at a time when cultural globalization is impossible.

This is the kind of problem that political science must solve. Surprisingly, the way to do it is by encouraging further research in physics. That is the only way to address the root cause of this entanglement. If one assumes that rational self-consciousness can truly emerge in our Universe, then all the necessary physical conditions for it must be fulfilled. By implication, complete knowledge about natural processes cannot entail contradictions with necessary human intuitions. Hence, the goal should be a deeper understanding of fundamental physical properties, in order to restore the harmony between science and society. As shown in this dissertation, many requisite qualities have been confirmed already, but some have yet to be discovered. At least one of these features is likely to call into question existing interpretations, and cause a chain of events that lead to favorable transformations beyond the proper domain of science. As argued, this could lead to better models for democracy, and even increase its appeal across cultural boundaries.

ADDENDA

ADDENDUM TO CHAPTER I

Reason, history and globalization

Globalization is a concept that, by definition, implies a transient process. Because of this, we do not have any kind of primordial value-tags for it. We do not really know if it is a good thing, or a bad thing. There is no reason to think of it as having some independent moral value. That being said, it is plausible to suggest that we have enough concepts to ascribe value tags to its hypothetical outcomes. Globalization might end up with terribly destructive results, but it might also lead to unprecedented growth and harmony across the globe. For each of these outcomes, we could select particular aspects of interest and quantify them according to our existing values. In other words, we could solve this problem by comparing the effects of globalization with those of other important processes in history. In the context of this discussion, it is important to ask: what are the types of events that can be considered as unequivocally good? Is there a particular quality that we seek when making this kind of value judgments? The history of humanity contains a long list of transformative events, but not all of them are examples of desirable progress. When trying to sort out various historical processes, it feels appropriate to distinguish actions that were motivated by local passing interests from those that were inspired by "greater reasons". The brightest achievements of humanity, especially in the social plane, are those that can be shown to serve – one way or another – as examples of "the triumph of reason". Whether we consider the emergence of trials by

evidence in ancient times, or the end of official discrimination on the basis of race or gender in the modern times, we see these developments as elements of progress because they elevate the value of individual human beings irrespective of their identity. We see them as comparatively more evolved manifestations of universal principles, such as "fairness", "equality", or "impartiality".

The relevance of reason as a marker of social progress was revealed with the greatest effect by the process of Enlightenment in Western Europe, which separated the Dark Ages from the Modern Era. The Middle Ages lasted almost a thousand years in which there was relatively little advancement in any field of human activity. The most remarkable part of this period in human history is summed up by the incredible abuses and arbitrariness that were possible in an environment in which a small group of people enjoyed absolute power. In contrast, Enlightenment stands out as a sudden transformation, which made possible unprecedented rates of development culminating with modern arts, sciences, technologies as well as numerous social and material advancements. The crucial element of this phenomenon is the fact that it was not preceded by some sort of outstanding transformation. On the contrary, it was a process that made possible all the radical transformations of the modern times. Prior to Enlightenment, the exercise of reason can be simplistically described as an undesired activity. It was equivalent to the presumption of doubt towards the word of God, and therefore was treated as an act of sin. When reason was redefined as a gift from God, and the best path towards understanding the purpose of God (i.e., as a virtue), the world could never be the same. Of course, some of the most famous transformations were accompanied by violent events. The point is that violence was abundant before and after

Enlightenment. It is the “triumph of reason” that makes all of the difference in our assessment of such past events.

This superficial description is only meant to suggest a possible standard for the evaluation of globalization. When it is over, are we likely to see it as a source of “darkness”, given the clash of civilizations that it might produce, or is it going to be a source of “enlightenment”? In order to make such an estimate about the future, it is necessary to consider the types of processes that are likely to end up with each of the two alternatives. The moment of enlightenment cannot be found at the end of globalization, except by accident, unless it is already present at the earlier stages. Also, it sounds like a safe assumption that any project of historical proportions should be carried out by large masses of people. After all, it takes numbers of organized groups to produce social transformations, and it is also at the collective level that subsequent readjustment has to take place. Accordingly, the prospects of globalization and its present-day evaluation depend on the answer to the following question: what types of motives are driving the large masses of people that are going to be responsible for the future state of the world? This may sound like a loaded question, because the most famous international events in recent years have been produced either as statements of cultural fundamentalism, or as responses to them. Still, the actual aim of this query lies elsewhere. Masses of people are made out of individuals, and each individual has to join a movement on the basis of some sort of motivations. When there is a choice between competing motivations, what tools are available for their analysis and filtration? If rational analysis was the main factor, we could have greater expectations for the effect of reason on the future of globalization. If emotions and irrational arguments were to enjoy a primary status in this process, a bias in

favor of fundamentalism is more likely. Consequently, the future of world affairs depends on the current social relevance of human rationality.

Globalization is a process of universalization. It leads to a state in which people all over the planet have similar daily habits, consume similar goods, and are subjected to similar information. So far, it is only a trend, but is already significant enough to elicit consequential reactions. The nature of these reactions is likely to be determined by the details of local cultural considerations. Thus, a uniform success of globalization can only be expected if it was accompanied by the emergence of some set of shared values. The tendency towards universal material practices must be paired with universal intellectual principles. The only plausible mechanism for a natural emergence of such considerations is through the effect of reason. This means that average people should find it more reasonable to cooperate than to struggle in the critical moments of decision, when confronted with contradictory calls for action. There are two major aspects to this issue. One is the practical problem that is of primarily concern to the students of mass psychology. Why do people favor one type of alternative over another in any given context, and what can be done to facilitate desirable outcomes? In the context of strategic analysis, this is essentially a question of control and management, and it is not relevant for the purpose of this dissertation. The other is the theoretical problem regarding the social relevance of reason. In stressful moments people are likely to act instinctively, according to their well established identities. However, those identities are developed and maintained through daily practices, choices, and sustained habits. Many of these activities are adopted through deliberation and careful consideration. To say that reason is socially relevant to one degree or another is to suggest that individual actions with public

consequences are informed by the belief in the aptness of reason to guide such processes and by the actual reliance on rational analysis in (the development of habits that are consequential for) matters of social importance. Accordingly, our expectations about the likelihood of emergence of universal values, as required for a preferable outcome of globalization, depend on our assessment of the actual social relevance of reason.

On the one hand, it may seem that modern societies are permeated by the effects of reason through and through. Most countries have constitutions and legal systems that are informed by principles involving justice, fairness, and due process. The levels of literacy and advanced education are not so low as to be worrisome. Overwhelming proofs of the validity of scientific reasoning can be found in all aspects of modern life, from gadgets to trash bags. Under the impression of such indicators, it should be very difficult to find excuses to doubt the validity of reason in modern life. On the other hand, there was hardly ever a period in history when the relevance of reason was discredited as thoroughly as it is in our age. Consider the example of an average person who has to decide about the best place to find guidance about his or her conduct in life. Suppose that this person has aspirations to be reasonable and to find a rational interpretation of existence in general. Presumably, a good way to form an opinion about the advantages of reason is to look at its results, as produced by the greatest thinkers in history. What would this person learn in this regard from a qualified philosopher? The most likely finding is going to be that reasonable principles cannot be shown even to prove that the world is real or that it is governed by universal laws in any meaningfully defensible way. The strongest arguments in this regard are still the skeptical demonstrations of Descartes and Hume. Next, this person is likely to learn that free will is most likely an illusion, and that

– according to the majority of experts on this subject – it is not even a meaningful concept, as commonly understood. Similarly, this person is going to find abundant arguments in support of the view that almost any intuitive idea that one has about the world is a demonstrable illusion. In short, the pinnacle of the human exercise of reason on philosophical matters is the demonstration of the inadequacy of reason to address the fundamental concerns of average human beings. As far as the foundations for any justified belief in the modern context are concerned, it is not an exaggeration to state that nothing is proven to be meaningful, except maybe a few arguments to the effect that nothing is meaningful.

Suppose further that the same person is shifting his or her focus to the existing record of knowledge in biology. This is indeed a good way to learn about the processes of life and about the rules of their manifestation. However, the operating mechanisms that are discussed by modern biological sciences are foreign to the actual way that life is experienced by average human beings. The theory of evolution explains the emergence of all forms of life by reference to a random process of mutation and selection. It describes a purposeless mechanism behind the apparent order of existence. No less relevant is the outcome of a cursory examination of neuroscience. Current medical research is supplying us with impressive amounts of data suggesting that the quality of human subjective experiences is dictated by physiological processes in the brain. These results go beyond clinical studies, becoming a growing part of our life in the form of pharmacological means for mood control. Under the force of these examples, one has to feel compelled to conclude that consciousness is epiphenomenal, being a mere reflection of underlying physical interactions. Yet, this description is at least intelligible with common concepts.

When the same person tries to get a sense of the deeper interactions in Nature, as understood by modern physics, even this virtue is lost. The main fundamental theories in modern physics are general relativity and quantum mechanics. The first of the two denies the existence of preferred frame of reference in the Universe, which is a nice way of saying that appearances are not determined by a fixed underlying reality. The second is asking us to assume that the governing principles for the observable facts of life are not even essential for the fundamental properties of matter. In quantum mechanics it is possible to discuss entities that emerge out of nothing, appear in several places at once, violate the arrow of time, and even change their properties on the basis of informational – rather than physical – considerations.

As a corollary of the above, the greatest fruits of reason – in science, as well as philosophy – have catastrophic implications for the intuitive understanding of life by human beings. The concepts that are used to describe the operation of humans as rational beings, which have so much internal appeal, are shown to be utterly inconsistent and self-contradictory. At best, it appears that no one can prove that they are not fundamentally flawed. The exercise of rationality to the highest degree appears to reveal the futility of the very principles that motivated humanity's belief in the advantages of rational thought. This is both ironic and paradoxical, considering the special place of rationality in day-to-day life, as specified above. This abundant reliance on reasonable practices in modern life is not grounded on good reasons, but rather functions in spite of all of them. It comes either from an abstract sense of confidence in common sense and general intuitions about the world, or some sort of theological dogma (if not both). For established social systems, this may seem acceptable, because everything appears to work well. Nevertheless, for the

fundamental transitions that are required for a peaceful development of globalization, this is far from satisfactory. Only reason can supply the kind of universal values that are needed for this process, and only if it can rely on appropriate solid foundations.

The current status of reason is not really a cause for panic, because science and philosophy are self-correcting enterprises. Unlike other value systems, which are based on some sort of appeal to extraordinary authority, rational investigations of the world are always “works in progress”, and all conclusions are under the threat of falsification and improvement, especially those that produce paradoxes. Thus, we cannot say that reason has doomed itself. We can only notice that the present interpretations in science and philosophy enjoy a very forceful support from large academic communities, with a small likelihood of change in the near future. This is enough to create a problem with troublesome consequence for the type of processes that unfold in the social domain, because people are forced to draw a line between rational spheres of activity, such as science and philosophy, and everything else. The world is artificially divided into isolated life domains. On one side, there are these activities which require reason, and on the other side there are those in which reason is believed to fail. Except for a vague reliance on common sense, the majority of people are left at the mercy of their spiritual counselors. Within the domain of academic activities, this state of facts may not seem problematic. After all, science needs its independence in order to achieve its valuable results. From a social point of view, this is a major reason for concern, because it is the status of reasons for the masses that determines the outcomes of large scale processes. For example, the revolutions that laid the foundation for modern social systems were so effective because they appealed to a sense of reason that overcame the proclaimed legitimacy of the status

quo. More recently, the events that lead to the end of the Cold War were made possible by the rejection of ruling ideologies by the masses, on the basis of rational arguments. It was the intellectuals who formulated the reasons, but it is the common folk who internalized them and acted accordingly. Moving back to the context of globalization, the problem of faith-based violent movements brings forward the importance of individual choices for common people from "heavy" cultural environments. In plain terms, the people need good reasons to disagree in the face of dogmatic claims. Those reasons need to carry the sort of weight that is impossible when reasons itself is so forcefully presented as unreliable for the most important decisions in life. Consequently, this situation is unique because it is not about intuitive adjustments within existing social structures. Globalization is about transcending existing social micro-worlds, together with their cultural paradigms. This means that the issues involved in this process contain unprecedented complexities. The preferable outcomes for this situation cannot be predicted or even vaguely expected in the absence of strong foundations for the mechanisms that could ensure them.

Given the nature of these considerations, globalization cannot be expected to be peaceful unless the social relevance of reason in the modern world is changed. As world-wide interconnections expand, various sources of conflict are likely to merge into the cultural channel where the rationalization for confrontation is only too easy to find. If it is granted that globalization is irreversible, then devastating developments can be avoided only if all cultural systems are able to find a common ground for multilateral understanding. This ground cannot be provided by mystical or religions considerations, because they are the ones that are in conflict with each other and have strong historical

roots. In contrast, empirical facts and rational demonstrations are often accepted by people from any context, because they seem to be irrefutable. Consequently, if the diagnosis is that opposite beliefs foment the threat of war, perhaps common knowledge could bring the key to a solution. If people shared the same beliefs about themselves as humans, as well as about the Universe, there is at least hope that bridges across cultural divides are possible. On the other hand, if science and philosophy join their efforts in undermining the links between the facts of science and the essential elements of human experience, there is no room left for such hope.

As a corollary of the above, the greatest problem to be solved by modern political science is finding a strategy for avoiding global wars. As shown, the most far-going solutions depend on our conclusions about the place of humanity in the Universe. Is human intuition properly equipped to understand the world? Is it in conflict with the facts of Nature? Is it fundamentally self-contradictory? Is it able to ever produce certainty about anything? According to predominant interpretations in modern science and philosophy, the answer to these questions must be negative. Still, the stakes are so high that one must press on: how strong is the foundation for these conclusions? Are they final answers beyond reasonable doubt? Do they amount to the status of truth, or are they just matters of convention? Let us consider physics, for example. Most of the known phenomena in this branch of study obey intuitive principles. Only a small class – pertaining to the unobservable quantum realm – is supposed to defy common intuitions in catastrophic ways. Are these events established beyond any need for questioning? No. They are by definition unverifiable. They are simply postulated because no other assumption was shown to fit well with the parts that are known. Is it possible that some

unknown property of the Universe could still restore the ability to interpret those things in classical ways? In theory – yes, but in practice the hope appears to be lost. One would expect such hypothetical properties to be discovered by now, given the scientific means for investigation that are available, and the amount of effort dedicated to these questions.

If we move on to neurobiology, can we exclude the possibility of intellectual causes for human action? Is it not possible that some mental faculties could be sensitive to physical contexts, acting as insufficient but still necessary conditions for decision making (at least in special circumstances)? Again, this possibility has not been ruled out beyond reasonable doubt, but the perceived probability of its existence is vanishing, in the same way in which real physical causes are not expected in quantum mechanics. Finally, has philosophical skepticism established its truth in any final way? Negative. A final truth would require a premise that is a valid a priori, or a demonstration that some existential fact is valid a posteriori. Philosophers have identified the conceptual problems that must be solved before our intuitions are properly validated, they have also shown the difficulties that stand in the way of required solutions, but they have not produced definitive statements about the true status of human intuitions about existence and its main processes. As a corollary, the leading interpretations in modern science and philosophy do not benefit form the support of irrefutable arguments or evidence. They may be the strongest conclusions available at the time, but the problem of survival of humanity justifies a tougher approach to them. If we are to resign ourselves to the reality of an unending source of global wars, we better have some good justification. The same conclusions, which might enjoy a level of comfort in their own domain of inquiry, cannot be given the same leeway in this context.

The problem that motivated this dissertation is related to the role of human rationality as a possible solution to the clash of civilizations, and it falls into the larger theme of knowledge as a source of social change. The world is not ideal, and it is naïve to expect that people can just come together and decide to solve all their problems amicably in one day. However, it is more then relevant to know if some types of solutions are possible at all or not, as this can have a direct impact on the types of long-range strategies for international politics that are available. If human intuitions are fundamentally flawed and illusory to the best of our knowledge, then there is no alternative to arbitrary cultural beliefs. This would imply that global understanding on any issue of importance is impossible, even if people in fact shared the same types of intuitions. On the other hand, if human intuitions about the workings of the Universe were valid, in a manner that could be proven beyond reasonable doubt, a common body of socially relevant knowledge could be built on this, as a foundations for common understanding beyond the relevance of local considerations. Thus, we are presented with radically different expectations about the long range dynamics of global interactions in each case. In the first situation, peace can never be final, and it would always be a vulnerable product of bargaining and manipulation. In the second, peace can be a final state, at least in principle, and stability would only grow with the advancement of knowledge. If this assessment is accepted, the policy implications for international politics are similarly different. In the first case, peace is a matter of containment, with preferential considerations for the security sector. In the second case, peace is a matter of cultural evolution, with preferential considerations for the academic sector. In a simplistic framework of analysis (such as “guns are bad, and books are good”), it is vastly preferable to exist in a Universe in which the modern views

about human intuitions are wrong. Moreover, we could not exist in two incompatible universes at the same time. It has to be a matter of fact (even if not yet fully established by us) whether our intuitions about the world are misguided or not.

To state that reason can be socially relevant is to affirm the possibility of using rational analysis to reveal the compatibility between human intuitions about the world and human observations of the world. Given that so much of modern knowledge is produced by scientific means, the kind of compatibility that is required involves the possibility of demonstrating the relevance of scientific facts to the conceptual predispositions of rational beings. Hence, we are confronted by a problem in political science, which demands a different look at several important issues that belong to the fields of philosophy and physics. In the sphere of philosophy, we need to know if reason can lead to trustworthy conclusions, if it can produce justified conclusions about the nature of reality, if the intuitive assumptions about mental properties of rational beings can be shown to be meaningful, and other similar issues. Most importantly for this project, it is relevant to know if there any necessary connections between mental properties and physical properties, in order to acquire the power to link physical observations to conclusions about mental processes, but also to enable a discussion about the place of rational beings in observed material world. In the sphere of physics, it is not less important to know if current interpretive problems are avoidable or not. Furthermore, it is essential to understand if the hypothetical material conditions for mental manifestations are mutually compatible and meaningful ingredients of internally consistent physical systems. Finally, to make these findings relevant for projections in political science, there should be actual physical data to serve as evidence that our world

is indeed compatible with the hypothesized conceptual predispositions of human beings. If the fulfillment of such (high) demands were to be realistic, the emergence of a universal cultural paradigm would become a plausible possibility.

The specified requirements are related to some of the most difficult problems in modern science, and they seem to raise interpretive questions that might even seem controversial. After all, they cannot be helpful unless the human capacity for reason were to posses a kind of perfection that is independent of any developmental and/or evolutionary considerations. Similarly, the world is supposed to be intelligible with the kind of intuitions that are shared by people with average levels of education. Yet, the goal of this discussion is not to argue in favor or against of any of these statements. It is only to show that a permanent solution to an important problem in political science is possible, against predominant expectations, though it does depend on extraordinary supporting conditions. The elements of this solution belong to different fields of study, with corresponding histories and contexts. As currently known, many of these problems do not have acceptable solutions. Yet, they are all relevant in a unique way to political science, and it is relevant to know if there are any interconnections between these issues that otherwise might go unnoticed. Insofar as we are talking about hope, the question of interest is to see if some of these problems can be understood better with a unified approach. Essentially, though, this is a methodological project, where the goal is to establish: what would it take to make it plausible that a universal cultural paradigm, matching the emergent “global village”, can happen naturally in our world?

The stated tasks of this project may seem quixotic, at first sight. Why should anyone expect a global cultural transformation in the foreseeable future? Why would

people be willing to abandon or even reform their religious and other cultural beliefs? The answer is straightforward, and it is based on the operation of the survival instinct. When people are willing to sacrifice their lives, it has to be for something greater. Moreover, it has to be for something that is deeply felt to be true. Calls for violent action do not always resonate that way, and the final decision must be based on some balance of arguments. More often than not, something is perceived as true because every other alternative is ruled out. In the context of globalism, if things escalate, people will frequently have to reconcile contradictory preferences. This is a source of growing internal tension that will require its own solution. As proven by the collapse of the communist block at the end of the last century, the discovery of an alternative for action is sufficient to produce the collapse of a cultural system. Adult people do not change their beliefs overnight, if at all. Still, the young generations – the ones that have to carry the burden of action – will express themselves by reaching for the alternative that sounds more truthful to them. Once the process begins, transition periods break the transfer of beliefs to the new generations. Gradually, but fast on historical scales (in just a couple of generations), the most active part of the society becomes the domain of members who have never experienced the practices of the preceding cultural paradigm. We have seen this at work in Eastern Europe, and other regions of the world that experienced fundamental social transformations. We can expect this to happen in the global society as well, if excessive internal tension will be paired with an appealing alternative.

The forgoing paragraph describes a motivating source for this research project, but it should not be taken as an essential part of the final conclusion. In the context of the following argument, it does not matter when and how global transformation might occur.

It is only sufficient to acknowledge that such a transformation is a best-case scenario solution for the troubles of the modern global society. The problem of interest is narrower: if a global cultural transformation is possible, is this a predictable process? If cultural paradigms emerged always as a matter of chance, without any foundation, then the hypothetical emergence of global value systems cannot be expected in any well-defined way, nor can it be something that would be guaranteed to persist in time in any predictable way. On the other hand, if the emergence of any paradigm was dependent on its ability to resonate with some sort of universal fundamental property of all human beings, then cultural evolution would become a predictable processes, determined by the ability to match informational content with intrinsic requirements. Let us assume, for the purpose of the argument, that there are several conceptual predispositions that are inseparable from the experience of being rational, over and above genetic hardwiring and/or developmental determinism. This would make human beings predisposed a priori towards adopting certain values, if and when the latter resonated with such hypothetical universals. Accordingly, we could develop an intuitive picture of the history of cultural systems. Modern religions are threatened by the existence of each other because they all claim to possess universal truths. Such a situation could not have emerged in a global society, nor could it have been designed for it. Rather, it is likely that they emerged in isolation, where their content matched the experience and knowledge of past times. Conversely, such religions cannot survive in their original form in a global context with a plurality of incompatible claims of universality. Their content cannot resonate with the hypothetical fundamental concepts any more, preparing the ground for a transformation. Some other overarching cultural system must emerge to fit the need for a credible

interpretation of those internal conceptual predispositions. This is not a claim that force and indoctrination are irrelevant in the process of cultural formation. Rather it is a claim that such maintenance will be increasingly the only reason for continuity, making them vulnerable for collapse at the moment of emergence of a more plausible alternative. Thus, the evolution of a global paradigm can be expected if some sort of knowledge were to emerge, filling the growing void that older systems would not be able to cover any more. This means that the emergence of a significant change in cultural values on a global scale can be a predictable phenomenon. The possibility of actual predictions depends on the fulfillment of the following conditions: 1) to prove the reality of a universal predisposition towards perceiving some informational claims as true; 2) to identify the types of knowledge and methods of validation that would resonate with such a predisposition; 3) to identify the sources of such knowledge in the contemporary context, as well as their potential for producing such proofs in the foreseeable future.

In light of the preceding explanation, it should be clear to the reader that this work is not about the political and/or cultural processes of our time. Nor is it about specific projections about future social developments. The primary concern is methodological: to prove verifiability for a hypothetical process of major interest in political science, by investigating relevant philosophical concepts and their implications. The actual focus is going to be on considerations about the fundamental elements of rationality. What are the parameters of existence of rational beings? What are the necessary implications of such existence? What is the status of observations of rational beings? What, if anything, is true for a rational being? These are very challenging questions that have been debated for centuries. Many experts consider them unanswerable. Still, the specific angle of

approach, dictated by this research project, lead to several important revelations. The stated goal was not to find answers, but rather to prove the abstract possibility of providing such answers. Yet, when the framework was properly defined, several promising solutions followed as a matter of course, as the dissertation shows. This was greatly facilitated by the methodological innovation of this approach, which was to give up on the attempt to discover aprioristic ontological facts. Instead, the choice was to arrive at conclusions on the basis of contextual considerations. In other words, the intention was to produce a reverse engineering of the self-conscious rational experience, in order to identify the essential pre-conditions for it, as well as the relevant considerations for verification. This is what enabled the finding that existing natural facts are compatible with rational self-consciousness, after all. The existence of consciousness is not a necessary phenomenon, but its preconditions must exist with necessity, if it happens to be true. Remarkably, we do not need to know that it is true (and it is not clear if we could). It is sufficient to show that the facts do not rule it out, with necessity. After all, the social implications of science follow from the plain understanding of raw facts.

ADDENDUM TO CHAPTER II

Groundwork for the investigation of rational self-consciousness

This dissertation is not based on a value-neutral approach to social change. In fact, the motivation for the presented research comes from the belief that the current state of affairs is prone to catastrophic developments. Ideally, something about the world should be amenable to radical change, despite tremendous odds to the contrary. Specifically, the large number of inimical cultural systems should find a way to converge without violence. Such a proposal might seem startling, if it were perceived as a call to replace all religions by a single one, but this would be a misunderstanding. The intended target of this study is something more practical – something that has happened many times throughout history. The process of interest is the possibility of a fundament shift in the guiding principles that underpin the socially relevant interpretations of traditional values. It is these interpretations that are responsible for the difference between moderate and extremist agendas, and they are the ones that can and should be changed, if the course of history is to be affected. The proper analogy in this regard is the emergence of Enlightenment in Europe in the late Middle Ages, when major transformations became possible because the social status of reason was upgraded from "sin" to "virtue"[87]. In our

[87] Prior to Enlightenment, the use of reason was seen as an act of doubt against the word of God. Afterwards, it was perceived as the greatest gift from God, and the best way to understand the word of God. It is definitely not the absence of religion that made Enlightenment possible, even though its role in the society had to change as a result. The new status of reason was the revolution.

age, science and theology are treated as "non-overlapping magisteria"[88], and the principle of mandatory coherence between claims and evidence is on the opposite side of the wall from spiritual considerations. This, of course, does not mean that science is the only domain of justifiable statements. Nevertheless, optional adherence to the rules of reasonable argumentation provides insufficient protection against abusive politics and religious fundamentalism. Insofar as this is perceived as a problem, a valid solution would be to change the rules, making requirements of consistency and evidence mandatory in all socially-relevant discourses. Yet, this would only be possible if the boundary between science and theology were transgressed. In other words, scientific evidence should acquire a proven relevance for the principal intuitions of human beings, with bearing on theological arguments and their implications. Such relevance would be demonstrable, if it were also the case that the intellectual properties of rational beings are somehow dependent on the material properties of their existential environments. There is no reason to expect this to be the necessarily the case, but would it not be great if it were so? Hence, the subsequent investigation had a tentative beginning in the assessment that a certain scenario would be particularly desirable for the future of mankind. Given the current state of knowledge about the Universe, such an endeavor may seem a little "detached from reality", but there is too much at stake to just rule it out of hand. The important thing to keep in mind is that this approach dictates its own research strategy. The first step of this project has to be a philosophical effort, in order to determine if an appropriate metaphysical theory can be formulated to this end.

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[88] S. J. Gould, "Nonoverlapping Magisteria," *Natural History*, vol. **106**, pp: 16-22 (1997).

Philosophical research is rarely impartial. It strives to answer the most pressing concerns of its time. In the field of metaphysics, people appear to be motivated by the need to see that the world makes sense. Ideally, the Universe should be shown to be governed by non-contradictory principles. Relevant theories should also be able to prove logically that the main qualities of the world are necessary, or else the existence of human beings might seem accidental. Moreover, the consequence of any such theory should be a revelation of the necessary purpose of existence. In light of such considerations, it is not surprising that classical metaphysics should have been so focused on absolute ideas, universal truth, and pure reason. Nevertheless, modern philosophy is happily detached from such ambitions, having realized that they are unattainable. The search for absolute foundations must fall into infinite regress, or else grasp for contradictory concepts, such as "unmovable movers". Instead, philosophical progress has lead to the surprising realization that rational beings can only refer coherently to the objects and phenomena of their own observable world. Yet, many different worlds with various principles of consistency were shown to be possible too. There is a certain sense of irony in this story, insofar as it is fairly presented here. The goal to show that our world represents the only coherent mode of existence has lead to the conclusion that it *is* the only coherent mode of existence, after deducing that it *cannot* be the only coherent mode of existence. Of course, there is no paradox involved, because of the underlying relativity. Our world is only coherent for us, and every other possible world must be similarly coherent in a unique way for its own inhabitants. The apparent implication is that the main parameters of human existence are not predictable *a priori*. Still, this brings us to an important question: would any world be equally meaningful for any being that happened to be a

part of it? If an observer were to be transported from one universe into another, with appropriately modified memories to conceal the switch, would the context seem coherent anyway? The answer is most likely to depend on the nature of intuitive predispositions of the subject in question. If those predilections were produced entirely by experienced phenomena, then the switch would not be detectable. On the other hand, if there was a metaphysical element at the basis of some intuitions, then the "wrong" universe may or may not feel "right". The exact reaction of the observer would have to depend on the ability to fit together noumenal and phenomenal elements of experience in the new context. This means that the principles of contingency and relativity do not rule out the possibility of meaningful metaphysical conclusions. Some modes of existence may not have necessary properties, but it is necessary for the same qualities to be mutually compatible whenever coherence is established. This is just another way of saying that the cause of an effect must be present with necessity in the same deterministic context, if the effect is present. If it is a fundamental property of a conceivable universe that its subjects should have metaphysical properties, then the physical properties of the same universe cannot be arbitrary. They have to be compatible with such a possibility. Accordingly, empirical investigations *could* serve as a source of valid metaphysical conclusions.

This idea is not new at all. Indeed, it is at the center of all debates about the nature of reality. Who hasn't wondered about the implications of physical knowledge on metaphysical concepts? Still, what seems to be new is the explicit idea to reverse the angle of attack. Instead of looking outside, at the world, for clues about the true essence of our internal properties, the proposal here is to look inside, in order to identify verifiable external properties that must be out there with necessity, if what we perceive

internally is true. Our intuitions may be illusory, but they are well defined. If it were the case that they required exact configurations of material properties, in order to be true, then we could validate their content by carrying out relevant physical experiments. In short, the goal is to look for the necessary material preconditions for the manifestations of non-material elements of existence. This would be enough to establish the stipulated social relevance of scientific observations, as described above. We cannot know in advance if such properties are available. It is merely possible that they could be real. In this lucky eventuality, the hopes that looked like wishful thinking at the beginning of this text might be materialized. If it should turn out that the opposite is the case (*i.e.,* that there are no such physical markers to be found), then it would follow that the stated problems of globalization cannot have the intended kind of final resolution. To sum up, the strategy is to identify a model of reality in the absence of any strong reasons to believe that it is true. We want it to be true, because it would make a certain ideal outcome possible. However, once we describe the model and identify its empirical implications, then it could be validated to the highest degree with the tools of experimental science. If we are lucky to live in the ideal world, then we would have found the truth about it by accident, but it would still be the truth. What makes one type of models preferable to all others? It has to be the power to render the world completely intelligible in a meaningful way. No theory can be perfectly meaningful if it violates our strongest intuitions about reality.

The goal to bring together intuitions and knowledge about the world in an essential way does not exactly solve its own problems. In the early stages of this research, it was not easy to determine where to begin the investigation. Much of the initial effort

was invested into studies of neuropsychological phenomena, emerging trends in evolutionary psychology, information theories, and especially quantum physics. In the philosophical plane, works of monistic and pantheistic nature seemed appealing. Among the treatises that were particularly inspiring, a few stand out. These include books by Plotinus[89], Augustine[90], Spinoza[91], Descartes[92] and Heidegger[93]. In retrospect, it is hard to delineate the exact contribution of each source, or why it even seemed relevant at the time. Suffice it to say that all of these sources were instrumental in the initiation of an eclectic new line of thought that eventually acquired its own sense of consistency, without allegiance to any particular tradition. Throughout this project, internal coherence for the emerging theory was the main guiding principle, and it really grew on the ashes of numerous failed models. The only source of inspiration that remained recognizable at the end was not a book. It was *The Matrix Trilogy*, the blockbuster movie created by the Wachowski brothers[94]. In a way, the model that will be presented below can be interpreted as an example of "videogame metaphysics". The world around us can be interpreted as a virtual environment inside another universe. In other words, it is physical to us, but looks like a projected environment from outside. Non-physical inputs – if any – would be acting without extension in our space-time, but they may have their own parameters (including extension) in the external realm, or else have a source in yet another dimension[95]. The key distinction is that relevant videogame models can be of two

[89] Plotinus, *The Enneads* (Pantheon, 1969).
[90] St. Augustinus, *The City of God* (Hafner, 1948), and also *The Confessions of Saint Augustine* (Collier-Macmillan, 1969).
[91] B. Spinoza, *Ethics* (Dent, 1989).
[92] R. Descartes, *Selected Philosophical Writings* (Cambridge, 1988).
[93] M. Heidegger, *Being and Time: A Translation of Sein und Zeit* (SUNY Press, 1996).
[94] Warner Bros., 1999-2003.
[95] The Matrix analogy is very helpful for the understanding of the epistemological constraints of rational observers. Though, its ontological implications can be misleading. An agent in a virtual world is indeed

kinds: “launch-and-forget” and “action-required”. The first kind resembles the “clockwork” toy model for the Universe, in which God is assumed to create it, set it in motion, and then retire. The second model describes a universe that is only partly self-sufficient. It is either unable to function at all without external support, or it is full of indeterminate states that prompt sporadically for strategic input. The most interesting conclusion of this research is that “launch-and-forget” models cannot allow for the emergence of self-conscious rational actors. Intellectual autonomy and especially free will are delicate qualities that must be accommodated by very specific material configurations. This enables an extension of the discussion about relevant markers of reality from general properties (such as determinism, energy conservation) to rather exact implications about physical processes (such as relative velocities, field symmetries *etc*.). In other words, the difference between the two types of models is also verifiable.

The arguments in favor of the proposed model are going to be presented in pure form in the following text, mostly without references to other works on the same topic[96]. This was motivated by the intention to produce a truly convincing argument that can withstand scrutiny on its own. A valid claim that specified material manifestations require corresponding metaphysical implications depends on the existence of necessary links between the two kinds of elements. Moreover, the final version of this essay was developed on the basis of logical consideration alone. It would look artificial to present it

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placed in a nested environment, or a “universe within a universe”, but this distinction between internal and external realms does not correspond to a neat distinction between physics and metaphysics, even from the agent’s point of view. The internally discernible phenomena of the virtual world have to be analyzed in terms of objective properties that are determined by physical and/or metaphysical parameters. Both of these categories refer to properties of the created world, as made possible by the external hardware and software of the “machine”. From an external point of view, the realm is virtual and the mechanism that makes it possible is again subject to descriptions in terms of physical and metaphysical features. Of course, the external world can also be virtual for a yet another universe, and so on. The resulting infinite regress may or may not be important for ontological considerations.

[96] A few references will be provided in order clarify concepts, rather then adopt or compare arguments.

as if derived from one source with authority or another. Nevertheless, a brief comparison with relevant traditional approaches is probably appropriate within the scope of this introduction. To this end, a few parallels with the work of Descartes, Hume, Kant and Husserl are going to be outlined below.

Rene Descartes is the kind of writer that can turn any reader into a philosopher. He gave a truly inspiring form to the idea that reason can guide us to eternal truths, unveiling the mysteries of the ever-changing world around us. Moreover, he offered the greatest reason to believe that some claims are valid beyond reasonable doubt, precisely because we are able to doubt[97]. Descartes was often criticized for pealing away too many layers of reality with his radical skepticism, leaving us with too little to move forward in our investigations. Nevertheless, the opposite interpretation had a stronger appeal for the presented research. Descartes stopped short of removing the last and most important layer of subjectivity: the notion of the self. My act of thinking that I exist does not prove that I exist, anymore than it proves that the table in front of me exists, when I think about it. My ability to think does prove that something exists, yet there is a major gap between me – the thinker who says "I" – and the entity that exists to make thought possible. Consciousness must contain the potential for self-consciousness, and especially rational self-consciousness, but it is not identical with it. On closer analysis, it turns out that a whole world of observables is necessary for the link between these two elements, and that is the realization that made everything else possible in this doctoral dissertation. Though, in order to be more Cartesian then Descartes, his rationalist doctrine had to be amended. The sensible world, and even the metaphysical reality beyond it, can only be contingent

[97] *Op. cit.*

in this new approach. There is nothing to make them necessarily predictable by pure reason. However, we can use our reasoning powers to identify the necessary relationships between the knowable elements of existence. The foundations of existence may be arbitrary, but their consequences are not. It is these relationships that are “eternally” true, because they cannot fail if the Universe is internally consistent. Thus, we can start with our intuitions as they are, deduce their necessary preconditions, and then remove our doubts about the world by verifying the fit between required properties and detectable manifestations. Another important concept that had to be amended was the mind-body dualism. Descartes considered the possibility of material effects on the mind, but maintained the functional independence of soul and body. In contrast, no such independence is implied in the proposed model. The mind is rather conceived as an inseparable interplay between physical and metaphysical properties. Dualism is not abandoned completely, because metaphysical causes are expected to have physical effects, especially in the context of the discussion on free will. Still, this kind of dualism is merely functional, if not downright conventional. In the resulting model, mental properties are not separable from material properties in any essential way. It just has to be the case that rational agents require access to transcendental inputs, in order to operate as true sources of action.

The argument about rational self-consciousness is explicitly formulated in this dissertation as a solution for Cartesian skepticism. Nevertheless, it emerges as a synthesis of rationalism and empiricism. Therefore, it contains an implicit response to Humean

skepticism as well[98]. The main concern of Hume in this regard was the problem that rational claims about reality cannot be true *a priori*. Every valid statement has to be anchored on experienced facts in the absence of other foundations. This means that it is impossible to have reliable conclusions about unobservable causes and relationships that are supposed to be at work behind the veil of appearances. Without denying the validity of this position, a solution is found by showing that some modes of experience may depend by definition on observable and unobservable properties in equal measure. In particular, awareness of the self is subjective, but it is nonetheless an experienced fact, at the individual level. It qualifies as a reliable starting point, from an empiricist point of view, but the resulting argument leads to rational conclusions about the necessity of metaphysical influences. Of course, metaphysical properties are not observable, and should normally be dismissed as unreliable. In this case, however, non-material and material causal elements operate as equally indispensable parts of a single mechanism. Therefore, the reality of metaphysical components can be validated by their physical footprints. By testing the empirical conclusions of the rational deduction, both types of skepticism (rationalist and empiricist) can be overcome, at least in principle.

Another important departure from the conclusions of Hume in the text concerns the concept of induction. The well-known difficulty here is to prove that observable patterns may reflect actual laws of Nature. Just because something happens regularly in a well-defined way, we cannot infer that it will continue to happen eternally in the same way. Notwithstanding, some regularities in Nature are demonstrably special, if their existence is necessitated by the existence of rational subjects. According to the presented

[98] D. Hume, *An Enquiry Concerning Human Understanding* (Open Court, 1988), and *A Treatise of Human Nature* (Oxford, 1978).

model, the reality of rational self-consciousness is verifiable by virtue of its observable physical markers. Because of the empirical basis for the validity of specified rational arguments, Humean objections to both induction and causation can be overcome in the case of fundamental laws of matter. Many other relationships with the work of the Scottish philosopher can be found in the subsequent text. A notable example is the concept of free will, but it belongs to the discussions presented in the next chapter. These parallels will not be spelled out, but a learned reader will surely not miss them.

An inescapable demand at this point is to compare the proposed model with the main features of transcendental idealism, given the claims about a new synthesis of rationalism and empiricism. Kant attempted to solve the problem of reliable existential knowledge by limiting its scope[99]. Analytical truths about the world are tautological, he admitted, while synthetic truths (as understood traditionally) cannot be generalized beyond their particular context. This precludes the possibility of justified conclusions about objective states of the world (the so-called "noumena", or things-in-themselves). Nevertheless, *a priori* statements about the subjective states of the world (the "phenomena", or the world as experienced by any conscious being) are possible, because of the ontological subordination of conscious thought to the operation of transcendental categories. If the world cannot be experienced except in a certain way (for example, in space and time), then it is of course necessary that it will be observed with those qualities at all times. This is a very compelling argument, but it is nonetheless unsatisfactory. On the one hand, we do want to have knowledge about objective components of existence. On the other hand, many of Kant's phenomenological conclusions have not survived the

[99] I. Kant, *Prolegomena to any Future Metaphysics: that will be able to come forward as science* (Cambridge, 2004) and *Critique of Pure Reason* (Cambridge, 1998).

test of time, especially with regard to modes of experience that are supposed to be uniquely possible. These limitations can be overcome by taking into account the differences between consciousness, self-consciousness, and rational self-consciousness. The three concepts describe different stages of emergence, the latter ones being dependent on the existence of the former ones. The preconditions for consciousness are unique and universal, but every subsequent stage depends on intervening contingencies. Thus, rationally self-conscious beings should have predetermined modes of perception, but some of their transcendental forms and categories might not be universal. This makes it more difficult to establish the true preconditions for any phenomenal context, but it also opens the possibility of (limited) objective knowledge about existence. By studying the governing dynamics of phenomena, one can identify the relevant noumenal factors that enable the local modes of experience.

Consider the example of modern human beings, described as rationally self-conscious beings. Living in the age of computers, it is intuitively appealing to admit that the mind works like an information processor. The scope of all experiences is limited to the sensible inputs, operations and outputs. Moreover, it seems unavoidable to assume that this virtual existential realm is impossible without the effects of a functioning machine (such as the brain) that is not itself part of the phenomenal world. This intuition was anticipated by Kant with his arguments about mind as the only accessible noumenon, but it is not exactly obvious that this should be the only possible mode of emergence of rational self-consciousness. It just happens to apply to human beings. Hence, we can assume that this scenario is true for the purpose of the argument, in order to deduce its objective and subjective implications. The subsequent analysis reveals that the noumenal

world of the processor and the phenomenal world of information must be governed by the same principles, whenever rational self-consciousness can emerge. In fact, phenomena must be described as if there was an actual objective world behind them (whether or not this is the case). Accordingly, the study of the world can now assume the language of objectivity. It is the conventionally objective world that has to conform to the rules that enable the emergence of rational self-consciousness. When the agent is able to experience the sensible reflection of such a realm, physical and metaphysical properties become part of the phenomenal context. The actual presence in the "right" environment (also called an "existential realm" in the following subsections of this chapter) is verifiable with empirical tools, given the markers that are prescribed by rational analysis.

The abundance of references to modes of experience in this discussion has prompted comparisons with well-established phenomenological traditions by readers of earlier drafts. In particular, the approach of Husserl[100] seemed particularly relevant, because of his apparent motivation to address similar concerns. Notable parallels can be sensed, for example, in the treatment of objects of experience as primary theoretical elements, in the intention to draw conclusions about "things-in-themselves" from the essential properties of phenomena, and also in the preference to adopt Cartesian methodological tools. Still, the differences are more important than the similarities, in this case. The project of phenomenology was designed to develop a science without presuppositions for the study of intentional objects of consciousness. This was meant to be achieved by deriving the necessary features of appearances from their intuited meanings. Any entity in the experienced world must have a formal essence. To perceive

[100] E. Husserl, *Ideas Pertaining to a Pure Phenomenology and to a Phenomenological Philosophy* (Kluwer, 1980), *Logical Investigations*, (Routledge, 1973), and *Cartesian Meditations*, (Kluwer, 1960).

an object in a certain way is to have an immediate grasp of its universal referent, thereby experiencing it as it truly is, somewhat like a Platonic form. This sort of idealist objectivity is derived from pure subjectivity, at the cost of removing ontological questions (bracketing) away from consideration. Husserl maintained Descartes' motivation to get rid of all analytical contingencies, in order to reveal the essential properties of conscious experience that must be valid beyond reasonable doubt. He was also concerned with the problem of reliable perception that had lead to radical skepticism. In the end, he abolished it by denying the relevance of the distinction between reality and appearances. The mind can take *in* the intended essence of phenomena without any consideration about their actual existence.

Husserl has many compelling arguments in this regard, but there is more to experience than mere experience. Phenomenological efforts are frequently focused on pure subjectivity, as well as the relationships between atemporal essences of sensible objects and transcendental observers. This leads to important insights into the universal nature of experience, but the particularities of individual experience – and especially human experience – demand the consideration of additional factors. An important conclusion of the presented study is that the meaningful use of categories requires rational self-consciousness. This property, in turn, is ontologically subordinated to the manifestation of several layers of subjective and objective reality – preconditions that Husserl would rather strip away in order to get to the universal essence of the self. From this point of view, several phenomenological arguments appear less salient. For example, Husserl insisted that the preconditions for consciousness must be intuited directly, in contrast to Kant who saw the need to deduce them. He emphasized that any deduction

already depends on their being certain concepts that require their own derivation, and so on towards an infinite regress. It may look as if direct understanding were the only way to achieve meaning. Yet, this problem can also be solved by denying the need to face it at the individual level. The process of emergence of rational self-consciousness from a merely conscious state may unfold in an intersubjective context. If so, the concepts can be adopted from outside as part of developmental processes, without the need to derive their foundations explicitly, or to assume mystical intuitive powers. It is enough to have intuitive rules for validation of concepts after the fact. Even more important is the fact that the emergence and exercise of rational self-consciousness depends on the fulfillment of a well-defined set of ontological conditions. This means that all existential realms are not created equal. At the immediate level of perception, experiences are always meaningful and equally "real", because the intentionality of the objects of perception is fulfilled. Notwithstanding, the step from immediate perception to rationalized action is not guaranteed *a priori*. This means that the exercise of intentionality cannot be authentic and/or complete in the absence of essential ontological preconditions. That is why epistemological concerns must come back to the forefront, with the focus on the potential for correspondence between observations and ontological considerations. Indeed, the main objective of the following argument is to show that a solution to the epistemological problem is possible.

The problem of rational self-consciousness, described as an emergent faculty, is more complex than can be shown here. The goal of this investigation was not to give any definitive statements, or to express a commitment to any final position on the subject. Rather, it was to show that this problem can be studied with great effect, in a manner that

is relevant for political science. The concept of rational self-consciousness and its epistemological implications have been investigated primarily for methodological reasons. They can serve the dual purpose of grounding certain beliefs about human intuitive predispositions and of identifying the sources of knowledge that could have an influence on their social relevance. To this end, the reader is invited to “bracket” the forgoing comments, and to focus on the validity of the bare arguments.

ADDENDUM TO CHAPTER III

Groundwork for the investigation of free will

Human beings are supposed to be different from all other types of beings on Earth, because they possess self-awareness. Moreover, they are aware of themselves in a very special way. Human beings perceive themselves as sources of unconstrained mental activity. They can create systems of concepts, define rules of relationships among concepts, and then develop meaningful discourses within the boundaries of those rules. Arguably, this propensity for willful and meaningful communication is more important than the mere act of self-consciousness, because it translates into observable material outcomes. Inert self-consciousness might just as well be a property of inorganic matter, for all we know. The perceived capacity to operate as agents is what makes human beings recognizable internally (to themselves), as well as externally (to each other). Yet, this propensity for agency appears to be problematic, because it is inseparable from the notion of free will. It is hard to accept the possibility of agency, without also defining the freedom to originate actions as its essential attribute. On the other hand, it seems even harder to explain the possibility of free will. Firstly, it is not clear that it describes a meaningful non-contradictory process. Secondly, it is even less obvious how it can operate in a material context. Finally, it is an open question whether our Universe is governed by rules that could be compatible with free will, even if the former two concerns were overcome in a satisfactory manner.

On a superficial level, the notion of free will seems to be quite straightforward. To say that "I have free will" is to say that "I have the power to initiate specific courses of action". This is also equivalent to the claim that some actions occur for no other reason except the exercise of free will. A deeper analysis, however, leads to a well-known conundrum. A free action cannot be a random event, because it is supposed to be explicitly and willfully produced by the agent. Yet, if the action is not arbitrary, then it seems that it has to be determined by some preexistent state of affairs, be it physical or mental. That state must have its own source in a still earlier context, and so on. A search for the sufficient cause of any action appears to lead to infinite regress, or else with a well-defined source outside of the scope of the agent. If one holds on to the principle of consistency, it appears impossible to define an action as both non-arbitrary and non-determined without losing the integrity of the notion of agency. Finding the proper middle ground between determinism and randomness has proven elusive, as far as we can learn from the modern philosophical literature on the subject. Inevitably, something must be sacrificed, and it is our intuitive understanding that is usually devalued in the process.

The concept of free will is frequently described as the most voluminously debated philosophical topic of all time, and it appears that every known philosopher has had something to say about it at some point or other.[101] Modern philosophy is not an exception to this trend, which is probably a reason for legitimate concern. On the one hand, this means that the problem of free will is still not solved. On the other hand, this lack of solution never stopped anybody from trying their pen at it. Arguably, this could justify a suspicious attitude towards any claim about novel contributions to the subject

[101] R. Kane, "The Contours of Contemporary Free Will Debates", in R.Kane (ed.), *The Oxford Handbook of Free Will* (Oxford, 2002).

(including the present one). Still, there are two other things to take into account. First, there is no credible proof that free will cannot be solved. Second, those centuries of debate did not pass by without progress. Every philosophical study must begin with a set of assumptions. Some of them are helpful, others are misleading. Free will is not an exception to this rule. At the cost of so much futility, many appealing but unfortunate assumptions have been transcended, paving the way for fresh insights. A couple of the obsolete concepts, which are relevant for discussions on free will, must be mentioned in this context. Such is the belief that only one coherent mode of existence is possible, whose parameters could be deduced *a priori* with nothing but rational tools. A similar dead-end is the tendency to endow mental properties with mystical powers, as if they could play a role in the world without empirical consequences. If pitfalls like these are avoided, philosophical research on free will might still prove to be constructive. Instead of debatable arguments about necessary or highly probably properties, one could focus directly on contingent models that are meaningful. A well-designed model like this would have to entail observable implications, which should be more than enough for validation.

The preceding conclusion explains the motivation for the subsequent discussion, but it is not an accurate description of the current state of facts in the philosophy of free will. Modern debates on this topic are shaped by a set of parameters that were defined about 40 years ago. Their nature is not so much ontological, as it is conceptual. The philosophers of our age are primarily interested in two things. Firstly, is free will compatible with determinism? Secondly, is free will a meaningful concept? These are known as the *compatibility* question and the *intelligibility* question, respectively.[102]

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[102] R. Kane, *A Contemporary Introduction to Free Will* (Oxford, 2005).

Determinism is a fundamental methodological principle of science, but it is hard to determine if it is an absolute property of our Universe or not. Accordingly, the problem of compatibility leads to several alternatives. Assuming that determinism is real, free will can be real only if it is compatible with it. In the case of compatibility, free will cannot be described as causally efficacious. Under the contrary assumption that determinism fails, free will may be either causally efficacious, or not. All of these alternatives have advantages and disadvantages. Many philosophers have expressed support for each of them, but compatibilism has been the most widely supported approach.[103] The intelligibility question is developed in reference to the numerous paradoxes that are apparently inseparable from the concept of free will, especially as defined by the supporters of incompatibilism.

As one might expect, supporters of opposite views on free will do not share the same definitions. In particular, compatibilist philosophers discuss freedom in terms of its external aspects. Hence, a person is supposed to be free, when there are no physical or mental impediments for the exercise of its intentions or desires. If a decision is made in the absence of mental constraint or manipulation, if its exercise is not prevented by physical disability or any kind of external opposition, then freedom is supposed to apply. The focus is obviously shifted from the internal processes that enable choices to the factors that may intervene given that the intention for action is already there. Even the most intrusive obstacles to action that are considered, such as brainwashing or (hypothetical) remote mind control, do not touch the basic elements that are presumed by the intuitive understanding of free will. This omission is not accidental, because

[103] For a good introductory discussion of these debates, see *A Contemporary Introduction to Free Will*, quoted above, and references therein. For a more comprehensive presentation of all relevant positions, by their most notable advocates, see *The Oxford Handbook of Free Will (op. cit.)*.

compatibilist philosophers do not believe that the so-called "true" free will is possible. From their point of view, it is misleading to assume that a choice can be irreducibly "up to" a decision-maker. The past must have a causal effect on the future. If an agent could choose otherwise, given the same exact past, that would involve a violation of causality. Alternatively, if the decision is influenced by mental processes, the latter must also be reducible to a starting point that is external to the agent, or else fall into infinite regress. Finally, if the decision is not caused by anything, then it has to be random and independent from the agent, thereby acting as an impediment to freedom (like a limb that acquires a mind of its own, acting against the wishes of the person). To sum up, free will is described as compatible with determinism because it has a weaker definition, and also because the stronger version is believed to be untenable.[104]

In response to this position, incompatibilist philosophers have felt the need to argue that there is more to free will than that. They presented several highly technical proofs to this effect, all of which converge on the same essential claim. Namely, determinism does not make it possible for a decision to be up to an agent. If determinism is true, then all outcomes are produced by laws and events that were in place before the existence of any subject. This precludes the possibility of any ownership over the purported decisions.[105] This is known as the "Consequence Argument". Philosophers who accept the validity of such demonstrations may take one of two positions. They can

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[104] For a deeper understanding of the compatibilist positions, see D. Dennett's *Elbow Room: The Varieties of Free Will Worth Wanting* (MIT, 1984), relevant selections in Gary Watson's (ed.) *Free Will* (Oxford, 2003), and Derk Pereboom's (ed.) *Free Will* (Hackett, 1997). A historical introduction can be found in I. Dilman's *Free Will* (Routledge, 1999). For more explicit arguments against the possibility of free will in the stronger sense, see T. Honderich's *How Free Are You?* (Oxford, 1993), R. Double's *The Non-Reality of Free Will* (Oxford, 1991), and B. Waller's *Freedom Without Responsibility* (Temple, 1990).

[105] The Consequence Argument was notoriously developed as a book-length demonstration by P. van Inwagen in *An Essay on Free Will* (Oxford, 1983).

assume the validity of determinism and therefore deny the possibility of free will. Supporters of this position are known as hard determinists.[106] Alternatively, they can deny the reality of determinism and endorse a stronger version of free will. This is known as the libertarian position, and it is further divisible among accounts that endorse the possibility of metaphysical elements (agent-causal approaches)[107] and those that prefer to remain within the constraints of physical considerations, without stipulating explicit causation by the agent (teleological intelligibility approaches)[108].

Despite the variety of insightful contributions to the numerous aspects of free will, the current state of the discipline can be summed up with one word: stalemate. Supporters of compatibilism have presented important objections to the Consequence Argument, but they are not strong enough to rule it out. In response, libertarian philosophers have come forward with well-crafted counter-arguments, which are also not completely air-tight. Both sides can claim that new arguments in their defense are still possible, even though they are not yet formulated. The fate of this debate can be linked to the intelligibility question. Compatibilists believe that no final answer to this problem is possible, while incompatibilists disagree, but there is consensus on the fact that a

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[106] Modern arguments that fall loosely under the umbrella of hard determinism can be found, for example, in G. Strawson, "The Impossibility of Moral Responsibility", *Philosophical Studies*, vol. **75**, pp: 5-24 (1994), T. Honderich, *A Theory of Determinism* (Oxford, 1988), D. Pereboom, *Living Without Free Will* (Cambridge, 2001), and S. Smilansky's *Free Will and Illusion* (Oxford, 2000).

[107] Introductory discussions of this position can be found in various review articles, such as T. O'Connor's "Libertarian Views: Dualist and Agent-Causal Theories" in R. Kane (ed.) *The Oxford Handbook of Free Will,* pp: 337-355 (Oxford, 2002). Influential works include J. Kim, *Mind in the Physical World* (MIT, 1998), N. Malcolm, "The Conceivability of Mechanism" in *Philosophical Review*, vol. **77**, pp: 45-72 (1968), D. Davidson, *Essays on Actions and Events* (Oxford, 1980), R. Chisholm, *Person and Object* (Open Court, 1976), J. Bishop, *Natural Agency* (Cambridge, 1989), R. Taylor, *Action and Purpose* (Prentice-Hall, 1966), and A. Mele, *Springs of Action: Understanding Intentional Behavior* (Oxford, 1992).

[108] An overview of indeterminist theories can be found in R. Kane, *A Contemporary Introduction to Free Will* (Oxford, 2005). Noteworthy contributions include C. Ginet, *On Action* (Cambridge, 1990), H. McCann, *The Works of Agency* (Cornell, 1998), S. Goetz, "A Non-causal Theory of Agency", in *Philosophy and Phenomenological Research*, vol. **49**, pp: 303-316 (1988), and R. Kane, *The Significance of Free Will* (Oxford, 1998).

satisfactory formulation is not yet available. The problem, then, is to determine: where to look for a solution to the intelligibility question, and why has it not been found yet?

Considering the amount of ink that was spent on this entanglement, it is reasonable to assume that an obvious solution in its own terms may not be possible. The root causes of this situation must be found in the assumptions that have influenced the relevant investigations throughout history. For example, a crucial element in all of these debates is the status of determinism – a concept with unknown ontological status. Determinism is a core principle of science, and the world appears to be deterministic on many levels of analysis, but it is not a fact that Laplacian or Newtonian causality applies to the totality of all possible observations in the Universe. The laws of physics could be deterministic without failure, and yet insufficient to predict all possible events. They could also be frequently deterministic, but not without exception. Then again, they could be fundamentally stochastic. Ultimately, it is the appearance of determinism that has to be compatible with free will, and the rigid adherence to the abstract principle of infinite material causality may be unnecessarily restrictive for a proper understanding of the world. Similarly, the current debates on free will appear to limit themselves to only three approaches to causality. Events are expected to be predetermined, random, or uncaused. Though, it is also possible for a class of events to be determined by well-defined transient properties, whose exact parameters of emergence are not sufficiently determined by pre-existing processes. This looks like a promising opening for a fresh approach to the intelligibility question.

Finally, compatibilist accounts of free will are heavily dependent on the claim that rational agents can never act “otherwise”, given the same past history, for that would

entail a contradiction between the content of reasons for action and the corresponding decisions to act. This is a valid argument and it would be counterintuitive to oppose it, were it not for the fact that it is not always relevant. When a given past history determines a certain outcome, there can be no room for choice. Yet, free will *is* about choices: the past creates a situation with multiple equivalent courses of action, and the agent has to choose only one. If the past history leads to a junction with two opposite attractors that have equal causative power on a given object, then the past is indeterminate. It is precisely the function of choice to allow one alternative to manifest at the expense of the other, and this possibility is simply outside the scope of the proposed scenario. Compatibilist philosophers do have a point that most decisions are based on overriding arguments and cannot be free in the strong sense. However, this does not preclude the possibility of truly free choices among indeterminate alternatives. As suggested in the previous paragraph, such choices can be meaningful too, if they are based on well-defined emergent factors that are causally independent from all external influences (physical and mental alike). In short, free will of the strong variety is impossible only if compatibilist assumptions are accepted in the first place.

These comments have been made in order to explain the context for the presented discussion. Nevertheless, this chapter was not conceived as a response to any of the modern positions on this topic. Rather, it was motivated by the conspicuous absence of a specific approach to the problem of free will, which was needed for the goals of this dissertation. When freedom is analyzed as an essential property of emergent rational self-consciousness, libertarian definitions are the only ones “worth wanting”. If an agent is not allowed to act as an irreducible source of mental and physical outcomes, then its self-

consciousness can only be epiphenomenal, and therefore illusory. Accordingly, it is not even relevant to inquire about compatibility between free will and any other abstract principle, in this context. It was shown in the previous chapter that a rational agent can find itself in multiple existential realms, and just a few of them are expected to be hospitable for the exercise of its essential qualities, including free will. The problem of interest, then, is to identify external (physical) markers – regardless of their nature – that must be present with necessity, if and when free will is possible. As explained, radical skepticism can be overcome only if the objects of experience are demonstrably compatible with preconditions for their authentic observation. Identifying the stipulated markers is especially important for the wider goals of the dissertation, which include the possibility to discover an essential link between scientific knowledge and the fundamental intuitive predispositions of human beings. In short, the presented work is a result of independent research, discontinuous from other modern contributions to the problem of free will. Therefore, it does not contain references to other related publications, except when needed for the proper understanding of relevant concepts.

ADDENDUM TO CHAPTER IV

Introduction

The goal of this dissertation is to illuminate a methodological problem in political science. If it is hypothetically plausible that the world might go through a fundamental cultural transformation, then it should be possible to identify a mechanism for such a process. As shown, the operation of any such mechanism depends on the possibility of demonstrating the existence of a set of necessary intuitive predispositions for any human being. Moreover, it should be possible to prove the relevance of scientific facts to those predispositions in an essential way. In the preceding chapters, a solution to this problem was demonstrated in general terms. Yet, the need to satisfy both requirements determined the choice of a contingent model for the task. Therefore, the conclusions of the philosophical part of the dissertation are not automatically relevant for the problem of interest in political science. Only if the specified contingent markers are present in our world, then we can say that the model applies to our Universe.

The problem of compatibility between a virtual model and a real context is quite straightforward. The model indicates the properties that are essential, and the observer only needs to look at the relevant data to see if those qualities are confirmed. It may seem that the only difficulty should be the discovery of evidence. Some properties could be hard to detect, and their confirmation would be delayed. In actuality, things are a little more complicated. It is a peculiarity of modern physics that the amount of recorded

observations often exceeds the scope of available means to interpret them. This should not be read as a claim that everything that there is to know is already observed. (Far from it!) Nevertheless, it is the case that numerous phenomena are studied experimentally up to the theoretical limit of their detectable features without a corresponding ability to give them a final qualitative description. Sometimes, there are no tools to explain the nature of existing observations. Sometimes, there are too many equivalent theories that explain the same phenomena. In any event, for many of the most important physical properties of the Universe there are only provisional interpretive models. Some of them are more popular than others (e.g. the Copenhagen interpretation in quantum mechanics, or the hypothesis of multidimensional space-time in the theory of relativity), but none of them are accepted as the indisputable final truth in their area of study.

It cannot be the goal of a thesis in political science to sort out problems in physics. Nevertheless, the border between these two areas of study has to be crossed in special circumstances. When this happens, both disciplines can benefit. In this case, the relevance of an important philosophical conclusion depends on the ability of raw physical data to confirm it. We do not need to discuss the advantages and disadvantages of all the numerous interpretations out there. We just need to know if the actual evidence rules out a set of specific properties, or not. Yet, this means that a discussion of several interpretive models is unavoidable, in order to separate objective and subjective elements of knowledge from each other. For example, physical observations might be shown to rule out the possibility of free will, according to some of the most successful models, but also to confirm the same possibility in other approaches. It is important to understand the reasons for the arguments of each side. Yet, the ultimate arbiter is the data. If the

experimental evidence is compatible with the existence of rationally self-conscious beings (including humans) in at least one valid model, then any argument against the same feature is automatically falsified. Insofar as all scientific knowledge is gathered by human beings, physicists can also use this argument as a methodological principle. By focusing on more promising qualitative approaches, it might be possible to eliminate interpretive bottlenecks, created by the multiplicity of equivalent theories.

The three preconditions for freedom, which were deduced in this thesis, add up to a model for an alternative interpretation of the fundamental processes in Nature, with very clear experimental implications. Because of this, the discussion can progress from the grounds for theoretical compatibility to the most likely opportunities for actual validation. Most of the indicators for this new model are compatible with existing observations, but this puts it in competition with several other models that are already well established. That is why it is more expedient to focus on recent observations that are not yet fully understood, whose interpretation might benefit from the presented approach, and even on proposals that have not yet been tested at all. The most important prediction is that electrostatic and magnetic pulses could have superluminal speeds, as discussed in the main part of this chapter. Yet, there are also interesting observations in the areas of gravity, electromagnetism, and quantum mechanics that could either falsify or validate these new ideas. As shown below, there are good reasons to expect that future developments will upheld the validity of rational self-consciousness in our Universe.

Relevant gravitational effects

Gravity is the most likely phenomenon to be invoked in a discussion about the fundamental properties of the Universe, especially with regard to the hypothetical existence of an all-pervasive medium for elementary waves. Einstein's theory of relativity is at the basis for any serious research in this area, and it is known to work quite well without specifying the possibility of any preferred framework of reference. Though, it is still an open question if this is a final theory about the Universe, particularly because of its limitations in the domain of microscopic phenomena. Einstein's theory has two compartments: one is the special theory of relativity (STR), dealing with inertial systems that do not experience any acceleration, and the other is the general theory of relativity (GTR), which incorporates all sorts of acceleration (including gravitational). Of these two theories, STR is not compatible with the model of matter suggested above. This can be explained with the help of a macroscopic example. If two airplanes were moving side-by-side in the same direction, their passengers could choose to exchange messages. If they chose to shoot material entities towards each other, inertia would cause the objects to "fly" along with the planes, as they traveled from one point to another. It would look as if the planes were stationary relative to each other and the objects were just flying along the shortest path (like ping-pong balls).[109] In contrast, if the passengers chose to send complex wave-patterns towards each other, in the form of linear pulses, then inertia would no longer apply. The messages would always miss their targets, revealing the extent of absolute motion relative to the medium. This argument is independent form the demonstration that the observable speed of waves from inside a medium would be

[109] For the purpose of the argument, the effect of air drag is ignored.

invariant (in particular, for round-trips of wave signals), as argued in an earlier section of this chapter. It simply shows that some wave properties (even if not all) may violate Lorenz invariance. Nevertheless, these hypothetical violations of STR are not really a problem, because special relativity is not strictly testable. It is an ideal-type theory, because human observers do not have access to areas of space that are free from gravity. Accordingly, some phenomena may appear to support STR (such as the decay times of fast moving unstable particles in cosmic showers[110]), others may appear to violate it (like the Sagnac effect[111]), but in all cases the general theory of relativity makes better predictions, because it incorporates the effects of all types of acceleration.

The more important question is to establish if the hypothesis of propagating wave sources can lead to a macroscopic description of the observable Universe, without violating the known implications of the general theory of relativity. Preliminary analysis suggests that such compatibility is possible for already verified facts, especially when it comes to the main features of GTR (including, but not limited to, Lorenz transformations and space-time topology). Though, important discrepancies emerge as well, making the new model easier to verify.[112] The assumption that fundamental entities can only produce a fixed number of excitations per unit of time implies that all of them can serve as clocks for each other. In the absolute frame of reference, each source must make a fixed number

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[110] B. Rossi and D. Hall, *Physical Review*, 59, 223 (1941).

[111] http://www.fact-archive.com/encyclopedia/Sagnac_effect. It should be mentioned that the relevance of the Sagnac Effect to STR is controversial. For most scientists, the presence of acceleration during rotation is sufficient to disqualify this phenomenon as relevant. Yet, other scientists believe that Sagnac interferometry and Michelson interferometry share fundamental assumptions, and they should either be discarded together, or accepted together as part of the same theory. Respectable scientists have shared such views with me in person, and I have also attended conferences where such claims have been made. Several experiments are supposed to be under way to test relevant implications. References can be found on the web, and will not be quoted here, to avoid misunderstandings.

[112] G. Mardari, "Qualitative insights on fundamental mechanics" in *Journal of Physics: Conference Series 70 (2007) 012012*. Also at arxiv.org/abs/quant-ph/0208148 .

of steps, with corresponding action on the medium. Yet, the amount of generated energy, to be available for members of the same association of elementary entities, should vary with the absolute speed of propagation. The hypothesized elementary entities should divide their absolute motion into steps that result in absolute displacement, and steps that are consumed by orbital cycles around the common center of interaction with other entities (inside macroscopic particles). At high velocities, more units of action would be required for the completion of each internal cycle and a smaller proportion of energy would be useful for the internal dynamics of the particle. This could translate into a slowing down of internal time, relative to absolute time. Similarly, the speed of elementary sources can be locally invariant, because of the total effect of the waves of other sources on them. For interpretive purposes, this means that relativistic effects are determined by local mechanical processes, and not by some sort of metaphysical conspiracy to conceal absolute motion. In the case of terrestrial experiments that verified the reality of invariance, gravity should be the main reason for the observed effects, rather then the simple fact of the existence of an observer. Remarkably, this also means that the speed of light might not be the same in all contexts of measurement, even for observers from the same inertial frame. This idea – though independently derived – is not new, and has been previously discussed in internet journals as well as in print.[113]

According to the preceding comments, the speed of light must be invariant relative to the predominant source of gravity. In contrast, it could vary relative to inertial frames (such as spaceships) that have negligible effects on the overall gravitational

[113] According to Van Flandern (*Physics Letters A*, vol 250, pp: 1-11 [1998]), "this idea was popularized in [P.] Beckmann [*Einstein Plus Two*, Golem Press (1987)], and then widely discussed in the journals *Galilean Electrodynamics* http://msx2.pha.jhu.edu/~dring/gehtmls/gehome.html and *Apeiron* http://redshift.vif.com/default.htm, and occasionally in the *Meta Research Bulletin* http://www.metaresearch.org". (Some of these links are no longer actively maintained.)

potential. Hence, in the interplanetary medium, the Sun should be the predominant source of energy. Ergo, the speed of light should be constant in the heliocentric system of reference, but not in the system of reference of a fast moving space probe. If two vessels with synchronized clocks were in constant motion away from the Sun, one behind the other, their radio communications should take different amounts of time in each direction (when measured one way only). If the times of emission and detection of each signal are properly recorded, log comparison should reveal that messages always arrived faster from the first ship to the second, than from the second to the first. This is because the second vessel is moving towards the source of the signal (at the time of its emission), whereas the first vessel is moving away from it in the inertial system of the Sun. Considering the number of twin missions to Mars and Venus, it should be possible to verify this conjecture. Therefore, this is a promising area of research towards a better interpretation of the physics underlying relativistic phenomena.

A different phenomenon that seems to be relevant for this discussion is the Pioneer anomaly. This topic has enjoyed a lot of attention among professionals and in the media. Reported initially by Anderson *et al* [114], it concerns the fact that all the space probes en route to the edges of the Solar system display an unexpected constant acceleration toward the sun. Somewhat recently, this topic has been in the news again, because the anomaly has been extended to include several cases of acceleration towards flown-by planets as well[115]. It is important to note that many theories have been proposed to account for the Pioneer anomaly, but none of them has been accepted as final yet. Of

[114] J. Anderson, P. Laing, E. Lau, A. Liu, M. Nieto and S. Turyshev, *Phys. Rev. Lett.* 81, p. 2858 (1998).
[115] J. Anderson, J. Campbell and M. Nieto, *New Astron.* vol. 12, pp: 383-397 (2007).

special interest to our discussion is the analysis of Teocharis[116], who has looked at this phenomenon from the point of view of a model similar to ours. His work suggests that it is possible to overcome the anomaly by assuming that the speed of light is locally invariant but not universally constant. By taking into account the possibility that light might travel at different speeds in different gravitational media, one could remove the grounds for concluding that the space probes are accelerating. This hypothesis has yet to be confirmed, but it was formulated without knowledge about the model presented above. Its predictions support the implications of the presented model, suggesting a possible compatibility with the experimental record. Consequently, the Pioneer anomaly is another area of research that could become relevant for qualitative work in theoretical physics.

As mentioned in earlier parts of this chapter, gravity is a static field that could be constituted by underlying real waves, running away from the center of any cosmic body. This means that any source of gravity can be treated as a source of running waves. Whenever such sources are in motion relative to the universal medium, the overall field should become anisotropic. In a classical medium, a moving source must experience a Doppler shift. Hence, the field of any planet must be asymmetric along several axes, corresponding to its motion as part of the galaxy, star system, as well as its orbital motion. Though, it is hard to say if the anisotropy of a large association of bodies can be detected from inside in a straightforward manner. The only pattern of motion that is individual for a planet is its orbital motion. Accordingly, the gravitational field of all planets must contain a detectable dawn-dusk asymmetry, which should be stable against

[116] T. Theocharis, *Lettere Al Nuovo Cimento* vol. 36, p. 325 (1983). This paper describes the model only. Relevant implications for the Pioneer Anomaly were presented by Theocharis in a less rigorous article, presented in the Canadian online journal *Episteme* (also available upon request) with the descriptive title "Space Dependence of Light Velocity May Explain Anomalous Effect Seen in Distant Spacecraft".

all local sources of variation (such as changes of mass distribution due to tides, ocean currents, etc.). Moreover, the gravitational field should be stronger on the dawn side (in the direction of motion), if the presented model is to be validated. Such an asymmetry for the planet Earth should be verifiable as well, considering the amount of data that is already available. With the GRACE project [117] successfully under way, and several other missions in the pipeline[118], the hypothesis of a dawn-dusk asymmetry in the field of our planet might be tested beyond reasonable doubt eventually. For now, most analytical work seems to be focused on more noticeable seasonal and long-term variations, even though short-term effects are discussed as well[119].

It is also important to note that all the planets from the Solar system should have the mentioned asymmetry in their gravitational fields. Therefore, the hypothesis is also verifiable with astronomical observations, by virtue of gravitational lensing. It is known that Jupiter is massive enough to deflect the apparent position of distant sources of radiation. Moreover, current technology allows for very accurate measurements of these effects, as shown in a recent experiment. Kopeikin and Fomalont[120] have demonstrated the possibility of verifying the exact position of Jupiter on the basis of minute deviations in the observable position of eclipsed stars. They tried to use their observation for an estimate of the speed of gravitational waves. However, the important fact is that modern detectors are able to detect even small effects. This means that it should be possible to use already existing data, in order to see if the gravitational lensing of Jupiter varies before and after eclipsing a source of light. In response to our questions by e-mail, the

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[117] http://www.csr.utexas.edu/grace
[118] http://en.wikipedia.org/wiki/Gravity_Field_and_Steady-State_Ocean_Circulation_Explorer . See also http://www.springerlink.com/content/k464343553n52276 .
[119] http://www.csr.utexas.edu/grace/publications/papers
[120] E. Fomalont and S. Kopeikin, *Astrophys. J.*vol. 598, p. 704 (2003).

authors claimed that their data was not used to test for the specified type of anisotropy. It would be very important if someone did perform the necessary analysis, because Jupiter also has other interesting asymmetries in its fields. For example, radio images of the gas giant contain remarkable lobes, which appear anisotropic in most prints that were examined by us[121]. This is probably indicative of the dawn-dusk asymmetry in the magnetic field of Jupiter, which is independently verified[122], and which is also consistent with the implications of our model.

The quoted experiment by Kopeikin and Fomalont was actually designed to test the speed of gravity. This is another area of research that is relevant for the proposed model, because the speed of gravity would also manifest as the speed of propagation of changes within gravitational fields. Einstein postulated that this speed should be equal to the speed of light, because he assumed that to be the speed limit for all phenomena in Nature. In contrast, the hypothesis of elementary sources of waves implies that no unit of *matter* can propagate faster than light. The waves on the medium are produced by material entities, but are independent phenomena and might even propagate faster than light, for all we know. Actually, it is preferable to assume that the speed of waves is greater than the speed of sources, or else the interaction between sources becomes restricted. Furthermore, if the speed of light was equal to the speed of elementary waves, then light from the Sun would co-propagate with the constituent waves of the gravitational field. This means that any source of waves would experience the same local state of a field throughout its path of propagation, implying that the gravity of the Sun

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[121] See, for example, http://www.gb.nrao.edu/visitors/gbtour. Also http://www.spacetoday.org/SolSys/Jupiter/JupiterRadio.html.

[122] F. Bagenal, T. Dowling, and W. McKinnon, *Jupiter: The Planet, Satellites and Magnetosphere* (Cambridge, 2007). Numerous articles and general discussions are also available online.

could not affect electromagnetic radiation in any way that is proportional to the mass of the star. In order to induce any effect, such as the gravitational redshift, the elementary waves would have to catch up with the constituent elements of light. Therefore, gravitational redshift should not be possible in the presented model, unless the speed of elementary waves were greater than the speed of light. Accordingly, it would be a great achievement to verify the speed of gravity with experimental means, but it is not yet clear how to do it properly. Kopeikin and Fomalont[123] assumed that gravity could reveal its speed during the simple process of gravitational lensing. As a result, they concluded that the speed of gravity is equal to the speed of light, because the observed deviation in the position of a star by the field of Jupiter was not consistent with the position of the planet at the moment of observation. It was only compatible with the position of the gas giant at the time of fly-by of the detection radiation. In the opinion of many scientists that reacted to this experiment, Kopeikin and Fomalont verified the value of the speed of light, rather than the speed of gravity, because they did not check the effect of Jupiter on a terrestrial object. Gravitational lensing is usually assumed to bend the paths of propagating photons while they are in transit. Its effect should be stronger when they are closer to the source of gravity. In other words, light from the eclipsed star had to be deviated the most when it was near Jupiter, not when it reached the Earth. In contrast, Kopeikin and Fomalont treated the observed deviation in the position of the star as if it was an optical effect that happens at the site of observation. Consequently, this experiment was motivated by mistaken assumptions.

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[123] *Op. cit.*

On the other extreme of opinions about the speed of gravity, there are strong claims to the effect that it could be much faster than light, if not infinite. An interesting review article by Van Flandern[124] presented a list of arguments, on the basis of astronomical observations, in favor of the claim that the speed of gravity is faster than the speed of light by at least ten orders of magnitude. He lists several phenomena that should occur, in contradiction to all known observations, if the speed of gravity were equal to the speed of light. To name just a few, the distance of the Earth from the Sun should double every 1200 years, gravity should not be able to penetrate the event horizon of black holes, binary stars should have unstable orbits, solar eclipses should be different etc. Nevertheless, just like in the case of Kopeikin and Fomalont, it is not clear to what extent the underlying assumptions of this analysis are relevant to all possible models of gravity. It would seem that different hypotheses about the fundamental processes that accompany gravitational interactions should lead to different predictions. To make things even more interesting, there is also the claim of Podkletnov that he was able to produce gravitational pulses in the lab[125]. His unofficial results point towards a speed of gravity that is two orders of magnitude greater than the speed of light[126]. Clearly, this is a controversial area of research, with insufficient data for ultimate conclusions. Yet, it is increasingly evident that the speed of gravity is a verifiable phenomenon, and its discovery could serve as important tool for sorting out various interpretive models. For compatibility with the presented model, it should be faster than the speed of light, but not infinite.

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[124] T. Van Flandern, *Phys. Lett. A*, vol. 250, pp: 1-11 (1998). See also the debate that followed this article (G. Marsch and C. Nissim-Sabat, *Phys. Lett.A*, vol. 262, pp: 103-106 [1999], T. Van Flandern, *Phys. Lett. A,* vol. 262, pp: 261-263 [1999], S. Carlip, *Phys. Lett. A*, vol. 267, pp: 81-87 [2000], T. Van Flandern and J. Vigier, *Found. Phys.*, vol. 32, pp:1031-1068 [2002]).

[125] E. Podkletnov and G. Modanese, *J. Low Temp. Phys.*, vol. 132, pp: 239-259 (2003).

[126] Personal correspondence, and public statements distributed by digital media.

Relevant electromagnetic effects

As suggested in the previous section, moving sources of static fields should experience deformations of their potentials due to Doppler effects. Moreover, these deformations should be detectable internally, from their own systems of reference. They should manifest as field asymmetries. It is not an excessive task to propose relevant experimental settings, in order to test this conclusion. However, it is instructive to note that the magnetosphere of the Earth has a well-studied dawn-dusk asymmetry[127]. This phenomenon is detectable in the form of diurnal variations in the geomagnetic declination, as well as via measurements of azimuthal distributions of the cosmic showers. It is just as interesting that Jupiter also has a strong dawn-dusk magnetospheric asymmetry[128], similar to other planets and moons from the Solar system. According to the proposed interpretation, all cosmic bodies that have magnetic fields should manifest asymmetries along their axis of motion. In the case of planets with counterclockwise orbital and axial rotation, the magnetic field should be stronger on the dawn side. It is important to keep in mind that magnetospheres are very complex fields, subjected to multiple causes for variation. Preliminary surveys of the relevant literature have not yielded enough information for solid conclusions. For a proper confirmation, all of those magnetic fields should be asymmetric in the predicted direction, and they should also be

[127] This phenomenon is mentioned in numerous textbooks on geomagnetism. A good starting point might be W. Campbell's *Introduction to Geomagnetic Fields* (Cambridge, 2003). However, the most explicit discussion of the dawn-dusk asymmetry can be found in recent research articles, focused either on theoretical models of Earth's magnetosphere, or on the patterns distribution of various phenomena. http://scholar.google.com/scholar?hl=en&q=dawn%20dusk%20geomagnetic&um=1&ie=UTF-8&sa=N&tab=ws

[128] http://www.igpp.ucla.edu/people/rwalker/Publications/AIPCP781952005%20.pdf. This is a link to an article that discusses the shape of Jupiter's magnetosphere. Various articles and images are also readily available online, with any search engine. This reference is intended as a minimal indication of the reality of the specified phenomenon.

stable enough to be attributed to constant Doppler effects. Nevertheless, it is already significant that these asymmetries exist, and they probably deserve more attention.

The interpretation of forces in terms of fundamental waves leads to a new way of understanding electrodynamic phenomena. According to currently accepted theories, magnetism is not really an independent force. It is a relativistic effect of moving charged bodies. With increasing relative velocity, charge weakens and transforms into magnetism. The same field can appear as electric in one frame of reference, and as magnetic in another. This relationship is hard to dispute phenomenologically. However, it does not seem to work in all cases. For example, it is a known fact that parallel currents attract, while antiparallel currents repel[129]. If the electrons from parallel currents move with the same velocity, they are practically at rest relative to each other. Instead of magnetic attraction, electric repulsion should be the dominant effect, but this is not the case. Another important feature of modern models is the assumption that charge has fundamental monopoles, and that magnetic monopoles could exist as well. These implications are in direct contrast with the model presented above. Under the assumption of fundamental generation, magnetic and electric waves co-exist at all times, despite the different macroscopic manifestations. Moreover, those waves can only be produced in pairs of opposite polarity, propagating in opposite directions. There can be no magnetic monopoles, or charge monopoles. The structure of charged subatomic particles is supposed to be such that electric waves propagate along the direction of motion. Due to the Doppler effect, the electric field must be denser in the direction of motion, producing an overall surplus of charge in most frames of reference. At the same time, the magnetic

[129] See, for example, *The Feynman Lectures of Physics* (Addison Wesley, 1963), but any college textbook on physics would suffice.

waves are orthogonal to the direction of motion and are not distorted like that. Their bi-polarity is always observable. This description entails that static electrons with similar orientation cancel each other's magnetic effects (in the rest system of reference), whereas their charge is cumulative. On the other hand, electrons lined sequentially in currents should cancel most of each other's electric force, exposing their magnetic force relative to moving targets. In conclusion, the assumption of fundamental generation implies that electricity and magnetism do not transform into each other. It is only their manifestation that depends on relativistic considerations. In terms of observations, this means that static configurations of charged particles should have detectable magnetic effects (as in the example with attracting currents). Another implication is that currents of charged particles should have detectable static fields as well. Such effects have been observed in the past[130], and they have yet to be conclusively interpreted.

A set of experiments with high voltage discharges, reported by Podkletnov and Modanese[131], is particularly relevant for this presentation. On the one hand, the authors showed that large numbers of electrons, released by a superconducting emitter through a rarefied gaseous medium, did not produce lightning sparks. They rather propagated in the form of flat disks, corresponding to the surface shape of the cathode, all the way towards the anode. The electric force should have caused the electrons to fly away from each other, even as they were attracted by the anode, because they were not in relative motion at emission. On the other hand, the discharges have also produced some kind of force beams, which propagated through material obstacles without absorption far beyond the boundaries of the anode. The beams had measurable effects on suspended targets,

[130] Consider, for example, the case of evanescent waves (http://en.wikipedia.org/wiki/Evanescent_wave).
[131] E. Podkletnov and G. Modanese, *J. Low Temp. Phys.*, vol. 132, pp: 239-259 (2003).

regardless of their electrical properties (charged and neutral alike). In our opinion, this experiment confirms the existence of static fields along the direction of propagation of electrons in currents. It also appears to support the hypothesis of underlying unity between charge and gravity. Since the publication of the quoted report, Podkletnov has improved his experiment, detecting the effects of these static pulses up to a mile from the site of discharge. He has made public and private claims to the effect that he was able to measure their speed of propagation with atomic clocks, but that his findings were too odd to be accepted for publication. The surprise was that the measured speeds were consistently superluminal, exceeding the speed limit for Einstein causality by two orders of magnitude. It is highly desirable to have such claims confirmed with independent experiments. Validation may not require costly developments, as suggested by the proposal with magnetic pulses, described at the beginning of this presentation. Until then, it is encouraging to see the remarkable consistency between Podkletnov's findings and the predictions of the qualitative model outlined throughout this thesis.

Another important phenomenon that must be mentioned here is the Biefeld-Brown effect. It concerns the fact that asymmetric capacitors display a measurable net force in the direction of the smaller surface. This tendency can be used to extract useful motion from static devices. Several years ago, a French researcher posted detailed instructions for several gadgets of this sort on the web, sparking an international phenomenon called “the Lifter Project”[132]. The term refers to a simple capacitor, built with a large (yet narrow) tinfoil cathode and a thin wire anode, stretched around a light wooden structure. Discharges are prevented by the air gap between the two components,

[132] http://jnaudin.free.fr/lifters/main.htm This site contains numerous links to papers and patents relevant for understanding the concept, as well as a rich database of visual demonstrations of the phenomenon.

and the whole device lifts into the air, when high differences in potential are applied (usually, between 10-30 kV). The cause of levitation, as shown in several experiments posted on the same site, appears to be the tendency of the charged tinfoil surface to move towards the wire with opposite polarity (which is fixed above it on the same frame). The tinfoil lifts the whole structure up, and even has enough potential left for a small payload. Earlier attempts to explain this phenomenon as an atmospheric ionization effect were falsified by demonstrations of the effect in vacuum, and other special set-ups. There are more than 350 registered replications of the lifter, built by amateurs from various countries, as well as several advanced studies conducted in professional labs. According to some interpreters, this type of propulsion should not be possible, because it appears to violate the principle of momentum conservation. However, this appearance is deceiving, according to the model suggested above[133]. The fundamental particles can never stop their constant motion, while the state of the medium determines the pattern and direction of their motion. In the absence of physical constraints, subatomic particles will react to each other's presence until all forces cancel out. Symmetry must be a final outcome for macroscopic observables, not an inviolable state. Hence, it cannot apply to capacitors with finite capacitance. Asymmetric capacitors will necessarily have unequal amounts of charged entities on each side. With charge being strongest in the direction of motion, according to our model, all particles should end up being oriented towards the side with opposite polarity. The capacitor as a whole is pushed in opposite directions by its two constituent parts, and the side with more charged particles wins. For a useful analogy, thrusters and lifters displaying the Biefeld-Brown effect can be compared to boats with two propellers on opposite sides. The net motion of the boat will be in the direction of

[133] G. Mardari, "Is gravity an electrostatic effect?" at http://jnaudin.free.fr/lifters/files/elegra11.pdf.

action of the strongest propeller. The principle of energy conservation is not violated any more than in any other experiment involving static electricity. If the momentum of subatomic particles was stored from an external source, as commonly suggested by many theories, this phenomenon would have been very difficult to explain. As a corollary, the Biefeld-Brown effect is a strong argument in favor of the hypothesis of constant and indestructible fundamental motion.

Relevant quantum effects

The central mystery in quantum mechanics is related to the concept of self-interference. As long as it is not fully explained with the intuitive principles of classical mechanics, everything else in fundamental physics will continue to look strange[134]. Self-interference describes the apparent ability of quanta to display collective behavior at the level of single entities. Isolated detection events emerge at random in relevant experiments, even though numerous detection events add up to non-random patterns. The most convenient way to account for this appearance is to assume that the final pattern is already encoded in the behavior of individual entities, or else that they have the mysterious ability to be in several places at once before collapsing on a single point. Moreover, they have to also appear as if they interact and do not interact at the same time, in order to change their detectable properties instantly, depending on our choice of method of observation. It is somewhat intuitive to account for the complementary traits of

[134] Richard Feynman famously proclaimed that this is "the only mystery" in quantum mechanics (*The Feynman Lectures in Physics*, vol. 3, p. 7 [Addison-Wesley, 1963]). Even counterarguments to this claim (such as M. Silverman's *More Than One Mystery* [Srpinger, 1994] – a very interesting book to read) do not question the basis for such a position, which is the assumption that each measurement distribution must be wholly encoded in single isolated quanta.

quanta by supposing that two or more behavioral patterns co-exist simultaneously in superposition, only to be filtered differently in experimental settings. Indeed, quanta do not change properties magically, in front of our eyes. They simply appear differently once the measurement set-up is changed. Nevertheless, it is much more difficult to account for this in terms of individual quanta. In this latter case, it is the same entity that has to contain two or more incompatible types of behavior. Filtration does not work as an explanation any more, because it looks as if the same quantum exists in several states at once, knowing in advance what information to reveal about itself.

These complexities of self-interference have been very hard to interpret, but the hypothesis of propagating sources of elementary waves leads to an interesting solution. The mobile units of matter are not allowed to interact directly in this model, as required by the preconditions for free will. Therefore, their associations will manifest as independent quanta producing random detection events in experiments. (Note that a single quantum is assumed to be an association of numerous sources of waves). At the same time, the waves of all sources must add up to a state of the medium that influences their relative arrangement. The exact position of each source must ultimately determine the type of "guidance" that it receives. The same entity could be at the peak of constructive interference with some sources, and at the troughs of destructive interference with others. In other words, the overall distribution of the energy of the field does not guide all entities to be in the same statistical pattern. At the microscopic level, several behavioral patterns must co-exist. Therefore, different distributions of detection events must emerge, according to the employed means of filtration. The crucial elements of this picture are the assumptions that quanta are not point-like entities (especially in the case of

photons, which are treated as longitudinal associations) and that their "pilot" waves result from the action of several quanta. Firstly, this means that the observed intervals between detection events cannot reveal the actual distance in space between quanta. Secondly, this implies that quanta can interact through their waves within limited boundaries. As the amplitude of their waves diminishes with distance, there must be critical intervals that cannot be crossed without consequences for the observable behavior. In short, the appearance of self-interference is explained with a verifiable mechanism that denies the reality of this property.

The hypothetical absence of self-interference has a few experimental implications that have already been tested, as part of unrelated investigations[135]. Two of them are especially relevant for the present discussion. Firstly, interference visibility must vanish when the physical preconditions for it are not met. Below predictable energy levels, which translate into quantum density per volume of space-time, an observable change in the statistics of detection events should occur. In the case of photons, whose action is proportional to their duration, these threshold rates must also depend on pulse-width. If single-photon pulses do not have finite duration, they will always overlap, no matter the time difference between any two detections. So, they must be chopped, or emitted in discrete pulses, while ensuring that they are mutually coherent. Secondly, individual quanta are expected to have well-defined trajectories. They can never take two paths or more at the same time. Therefore, interference should persist even in double-slit experiments, in which only one path is accessible at a time, provided different quanta have alternative access to more than one opening, before reaching the detector. In short,

[135] G. Mardari, "What is a quantum really like?" in *AIP Conf. Proc.,* vol. 810, p. 360 (2006), and "An alternative to quantum complementarity" at arxiv.org/abs/quant-ph/0409197.

interference should vanish where other models expect it to persist, and also to persist where other models expect it to vanish. At least for the situations that involve photons, both of these predictions are in agreement with the experimental record.

Several preliminary remarks are in order, before we look at the data. When a classical wave hits an obstacle with two openings, it will come out on the other side in the form of two waves, displaying interference in their area of overlap. In this sense, the original wave can be described as interfering with itself. Optical interference confirms the wave properties of light. Given this, should we expect the quanta of light to interfere with themselves? If quantized waves were similar to classical waves, then we should always expect self-interference. Yet, if photons were constantly produced as discrete oscillations by propagating localized sources, self-interference should be impossible. Every row of localized sources could only go through one slit, and the waves could not be reflected by material obstacles. Both of these possibilities can be resolved empirically, by looking for evidence of interference at extremely low energy levels.

Self-interference is also compatible with some pilot-waves models of light. Detection events (photoelectrons) can be assumed to be produced by particles (photons), whose behavior is determined by the profile of a wave. If detection events are considered independently, they do not display any obvious correlations among themselves. In the case of interference on a two-dimensional screen, each click appears random in space and time. Hence, if a photon is assumed to be the cause of a photo-electron, then photons have to be independent from each other. Each photon may represent the profile of the guiding wave as a whole (the physical equivalent of a formal wave-function) and that makes its manifestation perfectly independent of the presence or absence of other

photons. From an experimental point of view, pilot-wave models of this sort are indistinguishable from other interpretations, because they lead to the same predictions regarding self-interference. In contrast, the assumption of real sources of waves implies that there can be no waves without sources. The rate of detection of photo-electrons can only be diminished at the expense of the number of sources of waves. Therefore, it must lead to a reduction of the amount of waves, up to the threshold point where the profile of the "pilot-wave" is different. In other words, self-interference becomes impossible.

There are numerous experimental proofs of interference at very low rates of emission. However, the two conditions mentioned above (especially pulse-width) were not explicitly enforced in most cases. And in the few cases, when they appeared to be met, interference vanished. Usually, insufficient coherence at the source is suspected in such cases. In our opinion, the evidence does not justify such an interpretation. For example, Dontsov and Baz[136] suggested that discharge tubes, used as sources of photons, cannot produce coherent light at low levels of excitation. They demonstrated this by proving that interference vanished, when their source was weak. Furthermore, interference fringes reappeared, when they increased the output of the sources by two orders of magnitude. Nevertheless, when they placed neutral density filters behind the source, diminishing the rate of detection to the same low levels, visibility dropped again. It is remarkable that fringes were visible at the same rate of detection, when the filters were placed beyond the interference volume, in front of the detectors. Thus, interference visibility was independent from the technical state of the detectors, as well as from that of

[136] Yu. Dontsov,, and A. Baz, *Sov. Phys – JETP,* vol. 25, p. 1 (1967).

the source. The main factor was the number of photons passing through the interference volume per unit of time.

In a modern demonstration, Ribeiro and collaborators discarded the idler beam from a source of spontaneous parametric down conversion (SPDC), and performed a double-slit experiment with the signal beam[137]. They used a special set-up to achieve high rates of emission and controlled the pump (input) beams with neutral density filters. Narrow-band interference filters were used to screen for monochromatic detections only. The result was a very clear demonstration of interference at high emission rates, as well as of its gradual disappearance at lower rates. Unfortunately, Ribeiro *et al* concluded that their source cannot produce coherent photons at low rates, without testing for alternative explanations. They could have placed a neutral density filter behind the source, just like Dontsov and Baz, in order to see if fringes can be produced by coherent photons at low numbers. So, we have to look at other experiments for a proper interpretation. In one experiment, Kim *et al* controlled the exact interval between independent signal photons emitted in pairs[138]. As the time-delay between photons was increased, first-order interference gradually vanished. This shows that the interval between the quanta was more important than the state of the source for the final outcome. Though, a possible objection might be that spontaneous sources cannot ensure phase-coherence, which could be especially important at large intervals between pulses. Still, there is another experiment, by Kim and Grice[139], in which sub-wavelength adjustments of time-delay were achieved. In these conditions, maximum visibility was made possible by ensuring phase coherence between interacting photons. Still, interference did not persist after a

[137] P. Ribeiro, S. Pádua, J. da Silva, and G. Barbosa, *Phys. Rev. A*, vol. 51, p. 1631 (1995).
[138] Y.-H. Kim, et al., *Phys. Rev. A*, vol. 61(R), p. 051803 (2000).
[139] Y.-H. Kim and W. Grice, *J. Opt. Soc. Am. B*, vol. 22, p. 493 (2005).

threshold interval between photons. This evidence is sufficient for us to conclude that self-interference did not happen in a context, in which its preconditions were met.

It is also remarkable that interference happened even when quanta did not overlap in space, provided they were within the threshold boundaries. Furthermore, the interval between independent detections was larger for Dontsov and Baz[140] than for Ribeiro *et al*[141]. This is not surprising, from the point of view of the advocated model, because longer pulses must be physically closer to each other at fixed rates of emission. This element is well supported by the experiment of Santori *et al*[142]. They used quantum-dots as deterministic sources of photons to investigate interference between independent quanta. They clearly showed that interference visibility for comparable intervals was higher for quantum dots with longer excitation life-times, i.e. wider single-photon pulses.

A different requirement of self-interference is to have the two slits simultaneously open at any time that a photon can pass. Its function is self-evident, because the whole concept hinges on the ability of a wave to propagate from multiple secondary sources and generate interaction between its components. Thus, it must be impossible to get interference fringes with a single slit open at a time, if quantum self-interference is to prevail as a valid theoretical concept. Nevertheless, the reality of such a phenomenon was convincingly demonstrated. It is well known that interference fringes do not form when two slits are opened alternatively at a very slow rate. Though, it was shown above that photons do not produce fringes at very low rates of emission even with both slits open. The only relevant settings are those, in which quanta from both paths have sufficient

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[140] *Op. cit.*
[141] *Op. cit.*
[142] C. Santori, et al., *Nature,* vol. 419, p. 594 (2002).

opportunities to interact. Such a set-up was prepared successfully by Sillitto and Wykes[143], who used an electric shutter to switch on and off the paths of a Young interferometer. Remarkably, they were able to switch both openings several times before any single photon could reach the detector, even though the two paths were never open simultaneously. The estimated rate of emission was low enough to have no more than one photon at a time in the apparatus (10^6 quanta/sec for a transit time of 10^8 sec). Despite these measures, high quality interference was observed.

Even for people who accept the reality of self-interaction, this result is puzzling, because it seems to imply that photons can produce fringes from a single well-defined path. Still, this phenomenon was predicted before the experiment, on the basis of the argument that uncertainty plays a primary role in the Universe[144]. If the rate of path switching is high enough, at some point it must exceed the ability of a detector to resolve the paths, which makes them indistinguishable. This, in terms of the Copenhagen interpretation, proves that experimental uncertainty in our knowledge overrides physical properties. Even though photons had to take well-defined paths during propagation through the interferometer, they were not observable as such. This is akin to saying that human inability to see what goes on enables the manifestation of physical properties that have no real cause. Perhaps, some people might find this possibility interesting, but the details of the experiment do not quite support it. Uncertainty can only depend on the rate of switching if the arms of the interferometer are perfectly equal. This would be the only reason to expect that fast switching prevents knowledge about which path is open at any point in time. If one arm is longer, then uncertainty is erased again, because photons

[143] R. Sillitto and C. Wykes, *Phys. Lett. A,* vol. 39, p. 333 (1972).
[144] L. Mandel, *J. Opt. Soc. Amer.,* vol. 49, p. 931 (1959).

become distinguishable by the time of their arrival at the screen. Sillitto and Wykes did not have equal paths. In fact, they varied path difference continuously, until it was several times greater than the period of switching. Instead of destroying interference visibility, they showed that it oscillates periodically. If the electric shutter is treated as an intensity modulator, interference was perfect whenever both paths had the same amplitude at the detector. This means that the role of uncertainty is superseded by physical factors, such as intensity. Unfortunately, such an interpretation is precluded by the assumption that photons are point-like particles. As a corollary, we are presented with a choice: to declare this experiment a mystery, or to allow for an alternative interpretation of the structural organization of light. If photons are not assumed to be point-like entities, then the rate of detection clicks does not provide sufficient information about the amount of energy in each path. Accordingly, it is intuitively plausible that electromagnetic waves maintain classical patterns of behavior even when the intensity is low enough to produce well separated detection events. Nevertheless, interference visibility should still vanish at significantly lower rates of emission, as suggested by the experiments quoted above.

A very instructive version of the double-slit experiment was performed by Basano and Ottonello[145]. They used two independent lasers, well isolated from each other, in order to exclude any interaction between them, or between the photons, prior to interference. The beams of each source were prepared such as to access only one of two slits. Thus, every single photon had to pass through one slit at the most (or be extinguished at the screen). High visibility interference was achieved, even though self-interference was impossible. Again, the experiment allows for speculations that our lack

[145] L. Basano and P. Ottonello, *Am. J. Phys,* vol. 68, p. 245 (2000).

of knowledge somehow "washed out" the physical parameters of individual photons. Alternatively, one could assume that the lasers got "entangled" with the interferometer. Nevertheless, other experiments are adding up to close this loophole. Santori *et al*[146] have demonstrated photon bunching with independent deterministic sources. In their set-up, single photons were emitted on demand and their paths through the interferometer were well-known. No entanglement between the sources was possible in this case, because the emission process was deterministic. The photons had to have clear physical properties, even though their identity was lost at the detectors. In other words, the physical presence of coherent photons in the interference volume trumps over the informational considerations that might be assumed to cause quantum interference.

A possible objection to these last examples is that they refer to experiments with multiple sources. In technical terms, self-interference is an interaction of the first order (one quantum with itself), whereas the superposition of numerous quanta is a second-order effect[147]. By implication, the demonstration of one phenomenon should not be relevant for the interpretation of the other. Yet, it is precisely the argument of this presentation that there is only one phenomenon, not two. Even in the simple Young interferometer, where first-order interference is traditionally assumed to take place, the two slits can be treated as sources of radiation, as if they were two independent emitters. Moreover, the link between first-order interference and second-order interference is revealed in the experiments that demonstrate the so-called forth-order interference. This is a phenomenon in which an interference pattern is obtained via post-selection from a featureless distribution. In other words, a group of detection events is filtered through the

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[146] *Op. cit.*
[147] V. Scarani, *Quantum Physics: Interference, Entanglement, and Reality* (Oxford, 2006).

coincident detection of entangled photons from two beams. The rule of post-selection determines the nature of the pattern that is observed. The most relevant example for this discussion is provided by the work of Fonseca *et al* on non-local double-slit interference[148]. In this experiment, one beam (signal) was sent towards a detector through a rectangular window, producing a diffraction pattern. A second beam (idler) was simultaneously aimed at another detector, after being partially blocked by a narrow bar. Due to the position correlations of entangled photons, it was possible to select only the signal photons that passed at the vertical edges of the window, discarding all the photons that passed through the central part of the window. The net effect was a virtual double-slit interferometer, and the detected (post-selected) photons contained clear interference fringes. From an interpretive point of view, it may sound plausible that coincident measurements "collapsed" the wave-function of signal photons to a double-slit state, by invoking the non-local effects of entangled photons on each other. Still, even this explanation depends on the fact that entangled photons correlate strongly in their positions. Every time a photon was measured in the idler beam, its entangled partner from the signal beam had to have a well-defined position in the plane of the window. This means that every photon in the signal beam was either at the left vertical edge, or at the right vertical edge of the window, but never at both. Even in this virtual double-slit interferometer, photons definitely took only one "path". If they could not be present on both paths, even in principle, they could not self-interfere. And yet, it was precisely first-order interference that was supposed to be enabled by the "erasing" effect of the entangled partners on each other. This experiment has produced a very puzzling observation, from an interpretive point of view, but only if photons are assumed to be

[148] E. Fonseca, P. Ribeiro, S. Padua, and C. Monken, *Phys. Rev. A*, vol. 60, p. 1530 (1999).

point-like. If they are instead described as long pulses, then multiple entities from two paths can be close enough to interfere through their waves inside the interferometer, even though detection events may be separated by long temporal intervals. In other words, first-order interference is nothing but a disguised form of second-order interference. As explained above, this interpretation is verifiable, because it predicts the disappearance of interference at much lower rates of emission.

To sum up, quantum interference phenomena produce numerous interpretive puzzles, because of the apparent propensity of elementary entities to interfere with themselves. Large numbers of random detection events add up to non-random distributions, inspiring the hypothesis that individual quanta contain information about the whole process, manifesting it one point at a time. Despite the popularity of this interpretation, several experimental results appear to contradict it, as shown in this chapter. If so, then the theoretical gain from non-classical models is not great enough to justify their unconditional acceptance. In contrast, quantum interference appears much more intuitive if one rejects the one-to-one correspondence between detection events and the entities that produce them. Photons can be assumed to be very long linear associations of wave sources that pass through discrete points in the transverse plane of a beam. Each photon can produce numerous detection events at random points in time, as determined by the particularities of its local interaction with the atoms in the detector. In effect, different photons can be simultaneous (or closely separated in time), without producing detection events that overlap in space or time. The mediated interaction of photons determines their relative position in the transverse plane, which translates into well-defined properties for the detection events that they cause. In short, randomness emerges

as a feature of the interaction between photons and detectors, while non-randomness stems from the mediated mutual interactions of photons. This alternative interpretation has the special virtue of being verifiable. Therefore, it can help in the resolution of several interpretive problems in quantum mechanics. Conversely, quantum mechanics can become a source of knowledge that could be instrumental for the social processes that are discussed in the earlier chapters of this dissertation.

Summary and conclusions

The three preconditions for freedom add up to a model for an alternative interpretation of the fundamental processes in Nature, with very clear experimental implications. Because of this, the discussion can progress from the grounds for theoretical compatibility to the most likely opportunities for actual validation. Most of the indicators for this new model are compatible with existing observations, but this puts it in competition with several other models that are already well established. That is why it is more expedient to focus on recent observations that are not yet fully understood, whose interpretation might benefit from the presented approach, and even on proposals that have not yet been tested at all. The most important prediction is that electrostatic and magnetic pulses could have superluminal speeds, as discussed in the main part of this chapter. Yet, there are also interesting observations in the areas of gravity, electromagnetism, and quantum mechanics that could either falsify or validate these new ideas.

The general theory of relativity is largely compatible with the proposed new model, but there are significant interpretive differences, with corresponding experimental consequences. For example, Einstein's theory awards priority to the relative motion

between an observer and a physical process, which makes it seem as if the possibility of observation determines the value of measurement units for time, space, and mass. Alternatively, the fundamental physical parameters could be grounded on material considerations, such as the relative motion between a process and the physical context of an observer. To understand the difference, compare the assumption that the speed of light is invariant, because an observer could measure it, with the assumption that it is invariant, because of the space-time topology in the vicinity of an observer. One way to find out which interpretation is right, is to measure the speed of light in cases where the observer is in fast motion relative to the predominant source of gravity. For example, radio communications between twin space-missions to Mars, or to Venus could take the same amount of time go in either direction. It is also possible that they would not, if their speed were invariant only relative to the gravity of the Sun in the interplanetary medium. This could be tested by looking at the time of emission and detection of all signals, if such logs are available, comparing the one-way times of travel of radio waves in each direction. Another way to test this is to look for anomalies in the time of travel of electromagnetic signals from remote space probes to terrestrial detectors. If the speed of light changes because of physical factors, as it travels past several planets before reaching the Earth, then the motion of the probe should display the appearance of anomalous accelerations. As a matter of fact, there is a relevant phenomenon, known as the Pioneer anomaly, which refers to the mismatch between calculated distances to remote space probes and the times of travel for their radio signals. This problem is not solved yet, and various solutions are being considered. Still, there are proposals that involve the possibility of a variable speed of light, and they seem to work, according to preliminary calculations.

Regardless of the final conclusion of the scientific community on this matter, it will be instrumental for the potential relevance of the considered model.

In addition to the effect of gravity on the speed of light, it is also beneficial to consider the parameters of the gravitational force itself for theoretical progress. According to the proposed model, static fields could be produced by running waves, propagating outward from their sources. In the case of planets orbiting the Sun, this means that they should display dawn-dusk asymmetries in their gravitational field, because of the Doppler Effect on the elementary waves. There are many factors that could influence the transient patterns in the field of any planet. Still, with many ongoing projects that aim to produce a dynamic mapping of the gravity of the Earth, this hypothesis could be conclusively verified, eventually. Another source of confirmation is the research on gravitational lensing. For example, if Jupiter had a dawn-dusk gravitational asymmetry, then it would deflect the radiation from an eclipsed star with different power on opposite edges. This is a very small effect, but it is arguably within the means of modern astronomical tools.

Finally, the speed of gravity is also a crucial indicator that could be used to discriminate among competing models of the Universe. Einstein postulated that it should be equal to the speed of light, but the empirical record is not yet conclusive. Three representative positions were discussed in the text. One is the experiment of Kopeikin and Fomalont, which claimed to have confirmed Einstein prediction; the other is the analysis of astronomical observations by Van Flandern, who concluded that the speed of gravity should be at least 10 orders of magnitude greater than the speed of light, if not infinite; and finally there are the experimental claims of Podkletnov, who has measured a

rate of propagation that is greater than the speed of light by two orders of magnitude. Continued research on this topic is desirable. For the confirmation of the proposed model, the speed of gravity should be finite, but still greater than the speed of light, because it was argued that gravitational redshift would not be possible otherwise.

Electromagnetic effects are mostly studied in terrestrial labs, but there are relevant astronomical observations as well. Similar to the gravitational field, the magnetic field of orbiting planets should display dawn-dusk asymmetries. According to current observations, it is a fact that most planets and moons with observable magnetospheres display such asymmetries. Nevertheless, these are complex phenomena and it is not clear how well the hypothetical Doppler shift of elementary running waves can fit in existing models. In the case of the Earth, the dawn-dusk asymmetry is observed with multiple means, including diurnal variations in the geomagnetic declination and azimuthal distributions of various types of cosmic showers. The similar asymmetry of the magnetosphere of Jupiter is documented with terrestrial observations, and also with direct measurements performed by space-probes.

Electromagnetic phenomena are well understood by modern science, but their essence is still not completely explained. From a formal point of view, the manifestation of electric and magnetic forces is predicted by the relative motion between a source and a detector. When a charge is static, it is observed with an electric field. When it moves, a magnetic field becomes dominant. This observation motivates the assumption that magnetism is just a relativistic effect of charge. However, it is also known that co-propagating electrons attract, even when they display no motion relative to each other. Like charges should repel, and no magnetic force should be present among stationary

sources. This puzzle is avoided by the proposed new model, because it separates the observable parameters of electromagnetism from their physical causes. The detected strength of each force is shown to depend on the collective behavior of groups of electrons. In most cases, magnetism correlates with relative motion, but some configurations result in exceptional manifestations (e.g. when wires with parallel currents attract). Similarly, moving electrons could also display electric forces, especially in narrow cones in the direction of their motion. These expectations were confirmed by the described experiments of Podkletnov and Modanese, who studied the effect of massive discharges from super-conducting cathodes. Though, there is no consensus on the best interpretation for this recent experiment. Officially, it is still a mystery.

Another phenomenon that seems to demand a reinterpretation of electromagnetism is the Biefeld-Brown effect. It describes the tendency of asymmetric capacitors to exercise a net propulsive force in the direction of the smaller surface (preferably, the anode). As shown in the text, this effect can be used to build special lifters, which levitate as soon as they are connected to a source of high voltage, without any moving parts. Initially a curiosity that was mainly the domain of hobbyists, this phenomenon has received sufficient interest from qualified labs to confirm its main properties, as well the inability of existing theories to explain it. This has produced a theoretical void, which is why many different interpretive proposals have been made on this subject. Hopefully, future research in this area will bring out sufficient details for conclusive interpretations. In the meantime, this phenomenon seems to support the belief that free will is possible in our Universe. It can be treated as a window into the internal workings of matter, revealing the hypothesized indestructible motion of fundamental

elementary sources of waves. It is these waves that are assumed to take the form of fundamental forces (electric, magnetic, and gravitational), depending on the patterns of association of elementary sources.

The final subchapter is dedicated to the discussion of relevant quantum effects. The realist model with propagating sources leads to interesting interpretations for numerous non-classical observations. However, the goal of this discussion is to identify relevant means for conclusive empirical results, with discriminating qualitative implications. Theoretical physics already has too many models that are not experimentally distinguishable from each other. That is why the presentation was restricted to an analysis of the concept of self-interference. A unique feature of quantum mechanics is the fact that all interactions are assumed to happen at the level of single quanta. It is true that it takes large numbers of quanta for a single measurement, but every quantum is supposed to contain the whole result encoded in its wave-function. In short, elementary entities are not allowed to interact with each other in the leading models of quantum mechanics. This rule is compatible with the observation that quantum events add up to the same patterns even when they appear to be too far from each other for local interactions. Nevertheless, it should not represent a real phenomenon, if the preconditions for free will are met. Despite the statistical independence of detection events, their causative agents should not be functionally independent. Photons should engage in mediated interactions, and they should have the form of long trains of elementary entities – rather than point-like particles. This implies that quantum measurements should not look the same at all rates of detection. In special arrangements, involving very low intensities, qualitative changes in the patterns of detection should become observable. In

other words, interference patterns should vanish when they are still predicted to happen. At the same time, other configurations are possible in which interference is not expected by current models, but it happens nevertheless.

Both of these crucial properties are already tested, even if indirectly – as part of experiments with unrelated motivations. The experiments of Dontsov and Baz, Ribeiro *et al*, Kim *et al*, Kim and Grice were listed among those that gave important clues about the details of quantum interference. They all involved changes in the patterns of interference. Each of them was plausibly explained by their authors with reference to different experimental factors. However, when considered together, they did not add up to a coherent picture. No single explanation worked in the same manner in all cases. Such conflicts do not emerge under the assumption that self-interference is not a real phenomenon. This claim is not in conflict with existing formal models, but only with their interpretation. The equations of quantum mechanics describe the statistics of detection events, and only the extrapolations to unobservable causes are tenuous. Similarly, the assumption of real self-interacting quanta demands special conditions for the observation of interference. Chief among them is the requirement to have several indistinguishable paths available fro each quantum. A discussion of several experiments, including the work of Sillitto and Wykes, Basano and Ottonello, Santori *et al*, and Fonseca *et al*, was used to show violations of this expectation. The main conclusion of this discussion is that different interpretations can be sorted out with experimental arguments, by repeating some of the quoted experiments with slight modifications. Therefore, research in quantum mechanics can also lead to definitive answers about the validity of the proposed model.

To sum up, the possibility of freedom of "the best kind" in our Universe is supported by theoretical considerations, as well as by experimental results. The preconditions for free will have numerous observational implications, which is why they can be studied with different means, in several branches of science. In many cases, these properties are compatible with already existing models. In others, they lead to significant differences in predictions, and these were shown to be related to some of the most challenging puzzles in science that have yet to be resolved. Because of the attention that is currently awarded to these issues, new results and conclusions are likely to come in the near future. To the extent to which these findings are congruent with the predictions of the proposed new model, physics is expected to become a source of knowledge with considerable impact on the discussed philosophical issues.

ADDENDUM FOR CHAPTER V

Social constructivism and rational paradigms

The concept of paradigmatic transformation was introduced by Thomas Kuhn in his philosophical treatise on the history of science *The Structure of Scientific Revolutions*[149]. It incited numerous debates, mostly because of its implicit attack on the idea that the Universe is fundamentally intelligible with scientific means. Usually, science is believed to start from the assumption that our world is well-ordered and lawful. If every event has a cause, following form a prior event, and if all causes are governed by coherent natural laws, then it makes a lot of sense to believe in the reality of universal truths. With this in mind, science can be described as an enduring but finite project, inching its way towards a complete understanding of those ultimate facts about the Universe. Despite the appeal of this expectation, Kuhn argues that it is in conflict with the actual history of science. The progress of science has never been perfectly linear. It rather jumped from one conceptual matrix to another, according to the predominant theoretical framework of the day in the community of scientists. During periods of stable development, people are likely to believe in the reality of an underlying ontological picture of the Universe, assuming it to be consistent with the scientific worldviews of their time. Yet, previous generations had the same attitude about currently obsolete "truths" that were similarly incompatible with still earlier "facts" about Nature. The more

[149] T. Kuhn: *The Structure of Scientific Revolutions* (U. Chicago Pr., 1962).

we understand the nature of theoretical progress, the less likely we are to believe in the reality of those descriptions that inform the scientific approaches of our time.

Kuhn's work was focused on the process of rational investigation, and the extent of justified inferences from its outcomes. He showed that scientific research must obey a set of structural rules, with its peculiar advantages and limitations. Science is driven by questions and hypotheses, which resemble the process of puzzle-solving. In every puzzle, the shape of each piece and the overall content of the image are predetermined. It is this well-defined structure that makes the enterprise of puzzle solving meaningful and useful. Similarly, the rational study of Nature can only be successful if it relies on intelligible and coherent conceptual frameworks. Scientists are not piling together accidental observations in order to reveal the master plan of the Universe. It is quite the opposite: first they invent a plausible story about the Universe – a paradigm – and then they develop hypotheses about the relevant facts that can be found in its support. This is why every scientific project is premeditated, well-designed, and focused on specific details to be uncovered. Accordingly, scientists are always trying to confirm the details of the paradigms of their time. Moreover, science would not be a rational enterprise if it were to unfold otherwise. Revolutionary developments are possible precisely because of the meaningful relationships between expectations and observations. With this realization, Kuhn suggested that there is no teleology in science. The pursuit of knowledge progresses like biological evolution: from one theoretical framework to another, with increasing complexity and practical aptness, but fundamentally aimless and infinite.

It is very important to note that Kuhn was not just talking about shifts from "limited" understanding to "more encompassing" understanding of Nature. It is one of his

major points that new discoveries do not just fill gaps in previous theories. In times of radical change, one coherent description of the Universe is replaced by another equally wholesome picture. Perhaps the new conceptual matrix is more appropriate for the puzzles of its time, but it is not necessary for it to have a perfect fit with all known phenomena. In some cases, there may be observations that are actually explained with less clarity. Thus, paradigms are not really meant to provide a complete description of Nature, all appearances to the contrary. Kuhn, apparently, did not intend to suggest that there is no true reality, but rather that it is too complex to be ever captured in full by the limited capacity of human understanding. He made it very clear that successive paradigms are fundamentally incompatible with each other, in contrast to – say – alternative hypotheses that might share similar conceptual underpinnings. Because of this feature, the community of scientists cannot have a meaningful common basis until it adopts a single paradigm. Science is a collective enterprise and its greatest power becomes manifest when the absolute majority of researchers subscribe to the same conceptual matrix. There are dissidents, of course, who are unhappy with the unavoidable anomalies of every paradigm. Still, their access to resources and means of communication are going to be limited until the importance of their problems of interest cannot be ignored any more. Another interesting aspect is that individual scientists are often found to maintain adherence to their favorite paradigms even after revolutionary revelations. Sometimes, paradigms do not change until their main promoters retreat from active duty, making room for new generations of scientists. The greatest changes are frequently introduced by people who are young or new to a particular field of study,

bypassing the long years of training and practice that would condition them to see the world in a certain way.

The crucial aspect of Kuhn's work is that its object of study is methodology, and not ontology. Despite the worth of his conclusions, it is not possible to draw necessary conclusions about the reasons for their validity. For example, it is well known that Einstein's theories in physics are discontinuous from those of Newton in important ways. As Kuhn explained, Einstein's approach was closer in spirit to Aristotelian physics than Newton's work was relative to either of the two paradigms. Considering that scientific progress leads to increasing knowledge about the Universe, it is indeed striking that human theories should experience such dramatic reversals in their fundamental assumptions. The best way to makes sense of this is by assuming that former approaches have failed to capture the full complexity of physical processes. Still, it is not clear that these considerations are sufficient for an inference about future states of science. Kuhn has shown that the history of science does not conform to a linear teleological pattern. Yet, the swings of paradigms from one extreme to another can also be interpreted with a Hegelian teleology, as if they were moving from thesis to anti-thesis to synthesis, towards a final true picture. Kuhn's accuracy with regard to the sociological foundations of science does not carry into the realm of metaphysics. The specified facts are not sufficient for any well-defined conclusion. I find this situation similar to the problem of empiricism in the field of epistemology. David Hume made very important observations about our knowledge concerning causal patterns. If adopted as a literal ontological picture, his conclusions can lead to numerous interpretive problems. On the other hand, the same observations are beyond reproach within the confines of epistemological

projects. (It is one thing to say that we have no reliable knowledge about the true essence of natural causal mechanisms, and quite another to say that there are no causal mechanisms in Nature). In the same vein, Kuhn is persuasive that the succession of scientific paradigms does not point towards a clear destination. Still, he has not proven the necessary absence of any destination.

For illustration, let us consider the case of a pendulum that is allowed to swing in regular conditions on the surface of the Earth. The weight can be visualized as it travels from one side to another, passing the lowest point on its trajectory with the highest velocity. At first, it seems that the weight is trying to avoid the equilibrium point, rather then to settle down. Though, after sufficient time, it must begin to limit its motion to the central region. At this stage, if we looked at the record of all previous positions of the weight, we would still have insufficient grounds to claim that it should ever stop. Assuming that the medium is infinitely elastic, one could expect the weight to oscillate forever, even as its amplitude is becoming vanishingly small. Unfortunately for this expectation, the air is not infinitely elastic. At some threshold point, the potential energy of the suspended weight will become so small that even the air molecules will seem rigid relative to it, effectively putting and end to all oscillations. Similarly, a correct understanding of the history of scientific paradigms may show the absence of a linear pattern, or of any clear sense of direction, but this can not justify any inference about the ultimate outcomes of science, without some sort of compelling supplementary argument. In this case, the most pertinent external argument seems to undermine instrumentalist interpretations. The demonstrated power of paradigms to resist change would have prevented any sort of revolutionary shift, were it not for the corrective effect of novel

discoveries. Granted, scientific paradigms have to be developed before the fact, and this is why they are prone to imperfections. But how could they ever fail in any consistent fashion, were it not for an objective intelligible reality behind all of those observations that inform the invention of new theories?

Thomas Kuhn has provided a superior interpretation of the mechanism of progress in science. His book was one of most highly quoted titles of the twentieth century, shaping the course of many debates on methodology and ontology. Yet, the aspect that informed this dissertation is its power to illuminate an essential component of human nature. Science manifests the particularities of rationality in concentrated form, and as such it could be representative of other spheres of human activity as well, insofar as they can be interpreted as meaningful processes. Accordingly, it seems appropriate to raise the following question: might we be able to understand the dialectics of other types of social transformations, by analogy with the structure of scientific progress? Kuhn himself noted the existence of structural similarities between social revolutions and scientific revolutions. Though, his aim was to improve the understanding of the sociology of science. Here, the aim is to draw on the links between rationality and paradigms as a method of understanding social processes in general. This is not intended as a completely new project, but rather as a way to refine the existing understanding of social structures as, in particular with reference to the influential work of P. Berger and T. Luckmann on the *Social Construction of Reality*[150].

What does it mean to say that reality is (or can be) socially constructed? The title of the book is, of course, ontologically slippery, but it involves something quite

[150] P. Berger and T. Luckmann: *The Social Construction of Reality: A Treatise in the Sociology of Knowledge* (Anchor, 1966).

straightforward. Berger and Luckmann start with the distinction between the biological aspect of a typical human being, which is shared with other animals, and the social aspect that sets it apart from any other natural being and entity. The "human" part in "human being" is inseparable from the social aspect. The biological properties are essential to endow humans with the prerequisites for being "open to the world". Still, only the social experience can provide the connection from such raw beginnings to the fulfillment of a rational mode of existence. In simple terms, the world appears as overwhelmingly chaotic, as it presents itself to the mind of a child. Development towards a rational and meaningful way of life requires the existence of a structure, which provides order and directionality in the process of development. The society has to be in place as an objective part of reality in order to fulfill this goal, acting as an essential condition for the development of the human way of life. Nevertheless, it is a part of reality that cannot exist without being produced by human beings. Both in its emergence and in its perpetuation, society is produced by the active and passive effect of humans on it. We have to envision a dialectical process in which humans create society and are in turn formed by it. The mystifying part of this process comes from the fact that society is normally viewed as something eternal, as if it was inseparable from the Laws of Nature, without being so.

Berger and Luckmann identify several important stages in the consolidation of the social institutions, including habitualization, typification, legitimization and reification. Habitualization describes the tendency of individuals to perform a repeated activity in the same way. There are many ways to solve a problem, but one approach is adopted for one reason or another, and it becomes the norm. This diminishes the stress of decision-

making, increases the level of skill, and makes the relevant activities predictable. In other words, it brings about the benefits of order. When interhuman interactions result in specializations, such that different individuals are continuously associated with separate habits, typification emerges. Any time we can distinguish patterns of relationships, in which individuals are treated according to their social role, rather then to their individual traits, the operation of institutions can be invoked as an explanation. Though, at the stage of typification, institutions are still conventional. The emergence of roles is still remembered or perceived as an expedient fact. It takes the need to proliferate a pattern of interaction in order to bring it to the next level. When a given practice is being spread, vertically as well as horizontally, it needs to be explained, justified, enforced and/or ritualized, in order to embed it in the fabric of daily activities to a level that ensures the full extent of benefits from its institutionalization. This is how legitimization takes place. It is a continuous process, but it needs to be explicit only in the early stages, or when it is transmitted to new participants. When fully adopted, the institution is almost self-sustaining. It does not need to appeal to external authority. Its origin is either forgotten, or not even known. For younger generations it can become experientially similar to all other natural process from the same context. By this process of objectivation, an institution ends up being taken for granted as an eternal element of reality. In this sense, it can be described as being reified. If society is defined as the totality of reified institutions that add up to a coherent whole, then it can be adequately interpreted as a human construct.

This discussion of social reality as a man-made construction might prompt one to question the essence of existence, and to wonder about the best means to “break the spell” of “imagined communities”. Still, the theoretical problem that is involved in this

discussion is geared towards a more general concern. Society is inescapable and even inseparable from the core of our being as human beings. Even when societies seem to be in trouble, human beings can only escape to some other types of society, or else they lose their foundation for continued existence as rational beings. The problem of increasing the liberty of human beings cannot be solved by removing the constraints of society, but rather to understand what makes it work, in order to find the best way to improve it (i.e. to reconstruct it). In this regard, the anthropological insights of Berger and Luckmann and the structural analysis of scientific rationality of Kuhn appear to converge. Together, they seem to indicate that there is something fundamental about human nature, with respect to its need for meaning. This property is somehow co-dependent on nature and nurture, but it is also independent form both. In particular, the *need* for meaning is not something that can be easily reduced to biological considerations. Nevertheless, it cannot be described as artificially instilled either. Thus, the effort to bring together "paradigms" and "social constructivism" is not inspired by the description of rationality as a product of sociality. Rather, it is focused on a few aspects of sociality that can be described as manifestations of human rationality, and evolving according to the rules of the latter. In other words, we are looking for universal traits of all human societies, over and above the details that may have been created by the accidents and details of the actual processes of "social construction".

Society provides an ordered existential context for human beings by the very act of its existence, as Berger and Luckmann made it clear. However, there is more to it than that. For one thing, sociality is not unique to human beings. Indeed, since the publication of the *Social Construction of Reality*, our knowledge has advanced on this subject. For

example, a whole new discipline called “sociobiology” has taken shape. Moreover, there is a material advantage to social life that can be separated from its intellectual significance. Hypothetically speaking, human sociality should be possible even as a plain manifestation of “acquired reflexes”, similar to instinctive social behavior in other animals, though it would not be as complex and developed as we know it to be. Accordingly, it is important to separate the idea that social life follows some sort of rationality, in the sense of serving a purpose, from the concept of society as a symbiotic and dialectical component of this intangible network in which the power of rationality becomes manifest. It seems counterintuitive to treat each and every dimension of sociality as if it was conceptually compatible with paradigmatic analysis. Nevertheless, a few important aspects – at least the ones that are related to the cultural dimension – have many functional similarities with the conceptual frameworks that serve as paradigms for the scientific enterprise. Cultural systems have a much slower dynamics than modern science, and their standards for evaluation are not nearly as stringent with respect to evidence for essential claims. Nevertheless, they do conform to clearly perceived needs for meaning, and they also experience radical transformations for intelligible reasons in their historical contexts.

The concept of human nature has a well-known tradition as a source of social interpretation. In this context, however, we are interested in the nature of rationality as an explanatory tool. In particular, it seems relevant to know if there is any necessary consequence that could follow merely from the fact that a being is rational. It is at least intuitively plausible, as suggested by Kuhn, that no concept can be meaningful in isolation for rational beings. A whole matrix of referents and rules of correspondence are

required for this to work. Accordingly, the experience of rational awareness of one's own existence – assumed here to be a universal property of human beings – should not be meaningful alone. A being that happens to be committed to the statement of its own existence must also be committed to other connected concepts from the same matrix. For example, a being who declares "I exist" must simultaneously accept as true a set of related statements, such as "there is existence", "other things also exist", "I am not those other things", "I am in a special relationship with those other things", etc. This sort of commitment should be independent of the empirical grounds that might be available for such concepts, and it should even be pre-theoretical. In other words, to be rational and self-conscious is to be predisposed towards having a set of fundamental beliefs and expectations about the nature of the outside world. When a being with such predispositions is confronted with an existential context with an immense complexity of details, a functional gap should emerge. Such a being should be unable to cope with its reality, except under the protective custody of a mediating super-entity. The implication is that society is essential for the manifestation of human beings as human, in the manner described by Berger and Luckmann, because of this peculiarity of rational self-awareness. Yet, this also means that society is important not just as a structured environment. It is also important for its cultural paradigms that must be adopted by every independent member of a social group, in order to manifest their human potential in a meaningful way. Thus, it should be possible to look at the dialectics of social progress in its cultural aspects as if it was following the pattern of Kuhnian scientific revolutions.

Assuming that the preceding comments are plausible, all mature human beings should have a common problem. They should all be hardwired to expect the same

properties from the outside world, but their actual knowledge about the same world should be determined by the contingent experiences and historical circumstances. The gap between pre-theoretical expectations and actual knowledge would have to be bridged by the cultural paradigms of every human society. As long as the content of cultural systems is adequate for this task, societies should expect to be stable. When the growth of knowledge about external facts exceeds the competence of any cultural paradigm, instability should follow. In the absence of a better alternative, the old conceptual matrix might continue to persist. After all, any paradigm is better then none at all in this context. Still, a revolutionary change should happen as soon as an acceptable alternative becomes available. Just like in the case of scientific revolutions, proliferation and maintenance of paradigms should be ensured by the transfer of values from one generation to another. In mature adults, predispositions, paradigms, and knowledge about the world must make a coherent whole. The idea of switching any element from such constructs should be experienced as a counterintuitive suggestion. In the young adults, on the other hand, the process of adoption of a paradigm should be a flexible process, even if necessitated by the kind of knowledge that is possessed at the moment of commitment. This means that any cultural system, no matter how strongly supported by the members of a society, can vanish if the younger generations fail to adopt it. In plain terms, the advocates take their beliefs with them to the grave, but the new members of the society cannot be forced to adopt the same beliefs. It is the nature of this process that the systems with the greatest internal resonance, given the existing state of knowledge, must be adopted naturally. If something feels wrong, or if it does not make sense, this is just how things are, and no amount of force can change that. To be sure, force can ensure acquiescence, but it cannot

produce lifetime commitments. Moreover, force is costly in terms of resources for maintenance. As soon as it wears out, it can have no lasting effect. This point is well supported by the events from the final years of the Soviet Union. People of all ages had lived with the feeling of discontent for long periods of time, and when street movements allowed people to ensure each other of their solidarity, all attempts to use force have backfired and the country disintegrated. The expectation that revolutions are made by the young people was not accurate in this case, and the explanation has to be found in the fact that several generations have failed to commit to the existing cultural paradigm, because of its conflict with the knowledge about the external world.

This realization is of special importance for the contemporary geopolitical context. Modern information and transportation technologies are leading the world towards unprecedented levels of multilateral interconnection. The natural buffers that ensured the comfortable proliferation of several "universal" cultural identities through pre-modern history are now gone. It only makes sense for this to lead to ambiguity and tension with respect to cultural issues. The theoretical problem that seems to be less clear-cut is related to the inferences about the long-term outcomes of this situation. What is the likely result of a showdown between two incompatible cultures, or more? It seems that all of the discussions on this topic have been limited to only two alternatives: either one culture eliminates the other, or they learn to cohabitate. Yet, these are not real alternatives. There is only one expected development, which is on-going conflict. The first alternative is so terrifying that it serves to motivate the involved parties to strive for the second. Though, it is relevant to ask: why should conflict be the only expectation? Why should it not be possible for various cultural systems to come to a common ground

for mutual understanding? The answer is to be found in the predominant theoretical approaches to cultural phenomena. Mutual grounds require common values and beliefs that could be found either in some shared interpretation of the natural phenomena, or some sort of mutual fundamental cultural concepts. As suggested in the foregoing analysis of Kuhn's work, modern philosophers of science cannot defend the possibility of ultimate true knowledge about the Universe. The work of Berger and Luckmann is likewise representative of the attitude that cultural values are local and essentially accidental. Therefore, there are no universal concepts to justify the expectation that cultural differences could be overcome in any fundamentally relevant way.

Something is profoundly wrong with this state of facts. On the one hand, we are presented with ample evidence that the world is undergoing dramatic transformations, as part of the so-called globalization. On the other hand, we are implicitly asked to assume that all of those ancient cultural systems are going to be immune to change. If this was absolutely true, even in the long run, the prospects of perpetual confrontation would be undeniable. Though, it is counterintuitive to accept the thesis that ancient values could be able to persist indefinitely, despite the impetus of so many processes that grind away their foundations. It is surprising that the possibility of cultural change on a global scale is given so little attention in political science. If it is true that globalization is only going to intensify, and if it is true that existing cultural systems are most likely to lead to violent conflicts in this environment, then cultural change is the concept with the greatest theoretical value of our time. Two questions are particularly salient for this problem. First, why should change happen? Second, what kind of change is the most likely to happen? Both of these questions can be treated encyclopedically, with systematic

exhaustive analysis of all possibilities. However, in the face of costly wars among the representatives of large civilizations, there is only one scenario that really interests us. Ideally, we would want to know: is it possible for this problem to have a final resolution, and what types of strategies are up to us, given the goal to achieve such an outcome?

When there are several incompatible paradigms struggling for a single space of influence, the only successful finality is for all of them to be replaced by a single one. Aside form the undesirable violent scenarios, the preferable course is one that involves a natural transformation – a merger of all the supporters of competing value systems into a single community that endorses a single conceptual matrix. In the context of cultural confrontations, this implies the emergence of a new cultural paradigm to replace all of the old ones. Is it even remotely plausible to entertain such expectations about the world in which we live? Are there universal truths that could be invoked for the realization of such a process? It seems that the possibility of fundamental change is ultimately reducible to interpretive issues. Influential theories, like those of Berger and Luckmann, and Kuhn, can be – and indeed were – interpreted as arguments against universal elements in culturally relevant human knowledge. Nevertheless, it was also shown earlier in this text that an alternative approach to the same theories is also plausible. Cultural elements may be local because of the historical accidents in the acquisition of knowledge, even though they might be universally developed to fit a set of internal predispositions that are common to all rationally self-conscious beings. Similarly, intellectual paradigms might be discontinuous because of their need to provide complete descriptions of the world in contexts with insufficient knowledge. Presumably, complete knowledge about the world might only allow for one coherent paradigm. This means that it is possible for the

cultures of the world to change in similar ways, when confronted with an outstanding common interpretive challenge. It also means that it is possible for the Universe to work according to laws that make it unavoidable for human progress to lead to a single shared conceptual matrix with predictable content.

What would it take for a model like this to become important for contemporary political science? As a minimal requirement, all of its essential components should have strong foundations. Firstly, it should be possible to demonstrate that rational self-consciousness requires with necessity a set of conceptual predispositions. This should be a philosophical argument, demonstrating the universality of certain expectations about the world for any human being, regardless of the actual material conditions that might be sufficient for the existence of rationality. Secondly, it should be possible to show that rational self-consciousness and the material context for its operation are necessarily complementary. This requirement is essential in order to ensure that empirical observations have the potential, at least in principle, to eliminate any interpretive conflict between internal predispositions and external facts. Thirdly, it should be possible to extend this general property to specific facts, identifying exact properties that could serve as indicators of congruence between mental rules and physical laws. This requirement is meant to satisfy the condition that ideal cultural paradigms are theoretically possible. It must be conceivable that at least one possible Universe can accommodate the type of wishful thinking described above. Finally, it should be possible to argue that our knowledge of the Universe is compatible with the reality of the stipulated physical markers. After all, this whole enterprise is only relevant to the problems of globalization if it can be shown to produce a valid solution. In other words, the evidence should be

strong enough to convince us that a rational investigation of the Universe is naturally going to lead to a unique and final cultural paradigm for the whole world, eliminating the contradiction between the forces that define the current state of globalization. Though, as argued in the main part of this dissertation, such evidence is possible to obtain and, to a great extent, it is already available. By implication, the emergence of a global cultural paradigm is more than just a possibility. In fact, such a scenario can even be discussed as inevitable, if science is allowed to advance without interference. Such a conclusion is surprising, considering that it follows from the merger of two influential texts that – isolated from each other – shaped the emergence of relativism in social studies.

In light of arguments presented in this thesis, we can draw an important conclusion about the future of our world: the contradiction between global trends and local values can be eliminated by the emergence of a universal cultural paradigm. This statement is based on the demonstration that rational self-consciousness implies with necessity the existence of a set of conceptual predispositions and intuitive expectations about the world. The manifestation of this trait follows automatically from the moment of emergence of self-consciousness, and it is absolutely irrelevant if it was made possible by genetic, environmental, or even transcendental factors. Accordingly, this is a universal trait, specific to all human beings, which determines the need for specific types of informational content. It is the potential to resonate with such needs that is used to explain the appeal of any cultural value system. From a social scientific point of view, this means that radical cultural shifts are determined by predictable parameters. Systemic changes can be anticipated on the basis of compatibility between traditional values and contemporary experiences, coupled with the likelihood of discovering alternative sources

of knowledge. In the past, required informational content was gathered from purported mystical revelations. In the present, we witness the devaluation of such sources of knowledge and the gradual decay of their relevance for existential concerns. At the same time, we also see the emergence of an opportunity to satisfy these fundamental needs with rational arguments about empirical observations. This means that "clashes of civilizations" are pointless in the present world, because none of the existing cultural systems can link internal predispositions with existing knowledge about the external world. As the desperate struggles to maintain the status quo increase the pressure on young generations, the motivation to adopt appealing alternative values can only increase. Thus, we can expect that relevant knowledge will develop and have a formative cultural impact as a natural consequence of progress in science and philosophy.

DEDUCTIVE OUTLINE OF THE MAIN ARGUMENT

Part I

All purposeful behavior is goal-oriented behavior.
All goals require an agent that can reach them.
Awareness of a goal is impossible without awareness of the agent that can reach it.
An agent cannot have goals without being aware of itself as an agent.
1. Self-consciousness is a necessary a priori condition for any kind of purposeful action.

A complex entity (or process) is a sum total of a set of necessary qualities.
It is not an extant entity, unless all of its necessary properties are extant.
An entity must exist before it can produce anything.
Therefore, an entity cannot produce its own necessary qualities.
Eternal and uncaused complex entities are not exceptions to this conclusion.
Self-consciousness is a complex process with multiple necessary qualities.
Self-consciousness cannot produce its own necessary qualities.
2. If self-consciousness exists, its necessary conditions exist a priori.
3. Self-consciousness cannot exist unless its necessary a priori conditions are fulfilled.

The ability to express the existence of the self in a meaningful way is a necessary property of rational self-consciousness (by definition).
Meaning requires a basis for reference and a set of rules for correspondence.
The definitions of "self" and "non-self" are co-determinant. One cannot be meaningful without implicit or explicit reference to the other.
The definition of "self" cannot be expressed meaningfully without the principled operation of dichotomous categories.
The concept of dichotomy cannot be applied meaningfully without reference to a properly defined principle of deductive exclusion.
Deductive exclusion cannot be applied meaningfully, except as part of a coherent set of logical rules for analysis and meaning attribution.
4. The capacity for deductive analysis must be at work prior to the ability to express rational self-consciousness.

In a causally emergent universe, the emergence of deductive analytical rules must precede the emergence of self-consciousness.
Awareness of all activity of the self must with necessity occur after the emergence of self-consciousness (by definition).
Awareness of the reasons for the validity of deductive analysis cannot be available to self-conscious thinkers, as a consequence of the above.
5. A pre-theoretical intuitive preference for deductive analysis is logically inseparable from the ability to express the existence of the self in rational terms.

The rules of deductive reasoning are contingent but mutually coherent.
Only deductive conclusions can belong to the same conceptual matrix (system of notions and values) as the concept of self-existence.

The existence of the self is true a priori for rationally self-conscious beings. This existence is contingent, but its preconditions must be necessarily fulfilled, if it is true.
6. The rules of deductive analysis are valid a priori for self-conscious thinkers.

Self-consciousness is a mental (not physical) property.
It is also a process, describing the ability of the intuited self to produce independent mental operations.
Mental operations must be amenable to influence, before they can be influenced in any way.
Mental operations must be able to develop in a way that enables the emergence of rational self-consciousness.
7. A suitable mental context is necessarily prior to the existence of self-consciousness.

In a causally emergent context, the existence of an entity is necessarily prior to the existence of its contingent attributes.
Rational self-consciousness is a contingent attribute of some agents.
8. The existence of an agent, capable to acquire rational self-consciousness within its own mental context, is necessarily prior to the actual acquisition of self-consciousness.

The meaning of a statement follows from the exact nature of the relationships between the concepts that are used to make it (i.e the order of the concepts).
Whether concepts can be related to each other (or not) depends on the existence of some sort of context, in which such relationships can occur.
The relationships that give meaning cannot be preserved if their temporal and/or spatial parameters are changed.
Spatial and temporal parameters are necessary preconditions for order.
Awareness of meaning requires awareness of order.
9. Rational self-consciousness is impossible without awareness of meaning.
10. Awareness of space and time is a necessary precondition for rational self-consciousness.

Awareness of the self implies awareness of the present activity of the self as a process.
The present is an instant.
Instant events are not processes.
A process is experienced as a dynamic activity.
Awareness of present activity implies awareness of the fact that something is not finished.
Something is happening in the present, as it flows from the past into the future.
This requires awareness of the fact that past activity was also related to the same self.
Consequently, self-awareness must be impossible without the means to track the connection between the self and its mental activity.
This type of tracking cannot happen without a way to record and recall passing activities in their order.
11. Consequently, memory is a necessary precondition for the operation of rational self-consciousness.
12. The concept of “identity over time” is logically inseparable from the concept of “rational self-consciousness”.

Awareness of self implies awareness of (at least some of) the attributes of the self.
Awareness of self implies awareness of (at least some of) the attributes of non-self.
Awareness of self implies awareness of the relationships between various attributes.
Rational self-consciousness is ontologically subordinated to the operation of deductive principles of analysis. Moreover, its very emergence implies an act of deductive analysis. (*Therefore I am…*)
True (non-illusory) self-awareness cannot emerge in flagrant contradiction with the totality of experiences that define it.
True rational self-consciousness cannot emerge in the absence of sensorial grounds for coherent and appropriate self-affirmation.
13. Awareness of the existence of a world, in which the self is distinct from non-self and able to interact with it, is necessarily prior to the emergence of true rational self-consciousness.

An agent must exist before it can acquire rational self-consciousness.
An agent must be able to choose meaningful concepts at will before it can express its self-consciousness in rational terms.
It must be up to the agent to choose meanings for any concept at will, according to the purpose of the corresponding statement.
To express self-awareness is to reflect the perceived power of agency in the context of emergence.
True causally emergent rational self-consciousness cannot develop in flagrant contraction with the observations that define it.
14. Awareness of the experience of free will is necessarily prior to the ability to express one's self-consciousness in rational terms.

NB: The necessary preconditions for rational self-consciousness exist a priori whenever rational self-consciousness is a true phenomenon. However, the memory of a rationally self-conscious agent can only contain the grounds for processes that were discovered after the emergence of rational self-consciousness. Therefore, these preconditions are only available as intuitive predispositions, because they are logically inseparable from the affirmation of the self. They are perceived as true, just like the act of existence ("I think, therefore I exist", "I think, therefore I have memory", "I think, therefore I have free will" etc). The tendency of the subject to believe these statements does not imply that they are necessarily true. If rational self-consciousness is epiphenomenal, then it is not a true phenomenon and its preconditions cannot be expected to be true. Still, from the point of view of the subject, this possibility is irrelevant.

Part II

Deductive logical principles are logically and ontologically prior to the emergence of rational self-consciousness.
Any interpretation of the outside world must be compatible with the existence of the subject, if it is to be valid from the subject's point of view.
15. A rational self-conscious subject can have no superior alternative to the rules of deductive analysis for a coherent interpretation of the world.

The affirmation of the self is always relevant if it happens in the present.
The present content of memories is logically and ontologically prior to the ability to express the act of self-consciousness in rational terms.
The present affirmation of the self is always in relation to the perceived non-self.
16. The existence of a perceived world is also logically and ontologically prior to the ability of the subject to express the existence of the self.

Awareness of the self cannot be expressed rationally, except after the fulfillment of its necessary preconditions.
Relevant memories and sensorial facts are necessary preconditions for this ability.
The content of memories and perception, however they happen to be, are at least as real to the subject as its own existence as a subject.
17. A subject cannot assume its own existence without simultaneously assuming that its memories and perceptions are equally valid existential facts.

An existential realm is defined as the totality of sensorial and mnemonic phenomena that are relevant for the operation of a subject.
As a corollary of the preceding arguments, the contents of an existential realm are necessarily objective for an observer that is aware of its world in rational terms (i.e. its awareness is mediated by meaningful concepts).
Rationalized self-consciousness cannot have an independent essence. It is ontologically sub-ordinated to the existence of contingent appearances that define its affirmation in the present.
18. To admit that the appearances are not real, while assuming that the self is real, is to be in self-contradiction.

The world must always appear real as it is to the observer.
The affirmation of the self must always happen in the present.
It is the present content of memories, perceptions and operations that define the self-affirmation of the subject.
If the content of memories were to be somehow corrupted or modified, the subject would acquire a distorted idea of the self, compared to an earlier state.
Similar corruption may affect any of its mental faculties or perceptive organs.
19. The subject can experience multiple mental realms, one at a time, with different rules of internal consistency.

The subject is always ontologically subordinated to the reality of its presently experienced realm.
The present realm can only be perceived as real, or else the experience of the self as real would be in contradiction with it.
20. Only the present realm is experienced as real.
21. Other remembered existential realms must be perceived as less real, perhaps even dreams or hallucinations.

A rationally self-conscious subject can experience multiple existential realms without any immediate standard for discrimination among them.
The subject cannot make proper distinctions among various types of reality on the basis of perceptions, except to experience the present realm as real.
22. There can be no real and unreal existential realms. There are only presently experienced and presently not experienced realms.

For a brain-in-a-vat observer, the statement "I am a brain in a vat" is meaningless, *cf.* Putnam.
For an actual human observer, the statement "I am a brain in a vat" is false.
23. Rational observers have no means of coherent reference to alternatives to their ontological status, despite the contingent nature of their existential realms.

For any observer, the statement "I do not exist" is self-refuting, but not meaningless.
Refutation can only be valid in the case of meaningful statements.
24. The statement "I am a brain in a vat" cannot be self-refuting.

If the existence of the self is perceived as coherent, the existence of the presently experienced world is a priori coherent.
Assumptions about alternative possible worlds for the same self are a priori incoherent. (I do not know what is true. I just have an unavoidable bias in favor of the presently experienced realm).
25. Putnam's semantic argument cannot eliminate radical skepticism. It can only illuminate its intuitive foundations.

The statement "My world is not real" is incoherent.
The statement "My world is real, but its fundamental elements are contingent" is coherent.
The statement "My existence is dependent on the existence of contingent elements" is coherent.
The statement "I can experience different existential realms at different times" is coherent.
The statement "Any existential realm can only be experienced as real, because first-person references to other possible realms are incoherent" is also coherent.
26. Self-conscious observers, who are aware of their existence in rational terms, have sufficient means to express coherently the contingent ontological status of their existential realms.

Transcendental subjects (descended into phenomenal contexts, rather than produced by them) have purposes that go beyond the contingencies of experienced existential realms.
False existential realms could trick the transcendental subject, inducing behavior that defies its true intentions.
Transcendental subjects prefer to fulfill their intentions.
They prefer not to be tricked.
27. Transcendental subjects must be concerned about the reality of their existential realms.

Rationally self-conscious subjects emerge through contingent processes in pre-existing contexts.
Rationally self-conscious subjects are not transcendental subjects.
Rationally self-conscious subjects can only experience themselves and their existential contexts on the basis of the mutual coherence of concepts that reflect the details of their experiences.
28. Rationally self-conscious subjects must be concerned about the internal consistency of their existential realms.

If the existence of the rational self is true, then the reality of its preconditions had to be true at the moment of emergence.
Once the rational self has emerged, it can experience multiple existential realms.
It is not necessarily true that all of these subsequent realms fulfill the preconditions for emergence and proper operation of rational self-consciousness.
One can only *assume* that a realm is coherent with the rules and properties that enable the operation of rational self-consciousness, until proven otherwise.
A realm that is compatible with the proper operation of rational self-consciousness, as seen from within, must be treated as authentic reality.
A realm that is not compatible with the operation of rational self-consciousness should be treated as inauthentic (or illusory) reality.
29. The problem of radical skepticism can be solved by identifying internal (and therefore observable) properties of existential contexts, which can serve as indicators of authentic reality.

If there are operations, there must be something that performs operations.
If there are sensorial projections, there must be something that projects them.
If a phenomenal existential realm is observed, the existence of a hard context for is a necessity.
30. Existential (experienced) realms are ontologically subordinated to the reality of meta-realms that make them possible.

A rationally self-conscious subject cannot have immediate knowledge of the processes that enable its memories and perceptions.
The existence of such faculties is necessary. They are objective properties, from the point of view of the subject.
31. The objective entities that enable the operation of rational self-consciousness must exist in some sort of a meta-realm.

A rationally self-conscious subject can remember experiencing more than one realm (wakefullness, lucid dreaming, hallucinations etc.).
Continuity and persistence of identity is a precondition for rational self-consciousness. (I can believe that an action is *mine*, only if I can remember it as such).
32. There can be only one coherently intelligible meta-realm for a rationally self-conscious being.

The existence of a temporal order is *a priori* for a rationally self-conscious subject.
The subject could only emerge once (at the most).
33. Not all existential realms are equivalent. The original existential realm must necessarily be authentic. All other experienced realms may or may not be authentic.

Rational self-consciousness must emerge according to a coherently intelligible process.
Its emergence must unfold according to the rules that govern the original existential realm.
When rational self-consciousness emerges for the subject, the original existential realm suffers a qualitative change (it has a rationally self-conscious subject, in contrast to the preceding states).

A rationally self-conscious subject has the power to direct the activity of its sensorial means.
The objective substratum that enables the operation of those sensorial means is in the meta-realm.
When a subject acquires rational self-consciousness, it acquires the ability to knowingly influence the activity of its objective components.

34. Rational self-consciousness emerges as a qualitative transformation in the meta-realm, just like in the original existential realm.
35. The rules of the original existential realm must be consistent with the rules of the meta-realm in a way that makes possible the constitution and development of self-consciousness.
36. The original existential realm has a set of mandatory properties that set it apart from all other possible existential realms.

Explanation: In the brain-in-a-vat scenario, the brain must obey the laws of the external Universe, whereas the personality lives by the rules of internal (electronically projected) Universe. If the concepts of thought are supported by the functions of the brain, the two systems of laws must be coherent, in order to makes it possible for the brain to relate projected images to other mental elements that are dictated by its own properties. This is the analogy that should be envisioned for the relationship between original existential realms and meta-realms. Without nomological coherence between experienced and transcendental elements of reality, rational self-consciousness cannot emerge. Though, once established, it can experience existential realms of various levels of consistency. Only the initial context, in which the observer acquires self-consciousness, has the requirement of correspondence with the principles, if not the facts, of the first-order reality. Consequently, the existential realms can be compared to each other on the basis of their propensity to reproduce the qualities of the ideal-type original realm.

An agent must exist before it can acquire rational self-consciousness.
There can be no purposeful activity on behalf of the agent prior to the emergence of rational self-consciousness.
37. Rational self-consciousness must emerge as a natural effect of the experiences in the original existential realm.

The nature of the primary existential realm must be such as to enable the agent to realize that it is an agent.
The agent must truly possess the powers of agency in the experienced context.
The entities of the original mental realm must be experienced as well-defined, such as to enable the proper distinction between individual objects, as well as between self and non-self.
Certain events must be perceived to have the same consequences without exception, in order to justify the generalization that some processes cause other processes.
Awareness of the idea of causality as an unfailing principle in the experienced world is logically prior to awareness of oneself as a necessary cause of some observable effects.
38. As a corollary, rational self-consciousness cannot emerge on its own, except in an existential realm with well defined entities and deductively intelligible unfailing causal laws to govern their interaction.

Rational self-consciousness must emerge as a qualitative change within an ongoing mental process.
This change requires the operation of deductive principles of reasoning.
Self-consciousness is a precondition for purposeful mental activity.
39. The principles of deductive reasoning that inform the emergence of rational self-consciousness cannot originate in the subject.

A subject must be capable of filtering perceptions with deductively intelligible concepts prior to being aware of the source of those concepts.

The objective emergence of deductive principles in the mind of a thinker is either a necessary or an arbitrary effect.
If the emergence of deductive analysis is induced by arbitrary causes (or no causes), then the original realm does not have any necessary identifiable properties.
If the emergence of deductive analysis is a necessary effect of a causal mechanism, its parameters had to be determined by identifiable properties of the existential (mental) realm.
Objective properties of existential realms must be determined by the properties of the engendering processes in the meta-realm.
The properties of the meta-realm, which are directly responsible for the manifestation of the existential realm in the mind of a subject, cannot be sufficient for inducing deductive thought, unless they are also operating according to rules that are immediately intelligible in deductive terms.
Explanation: The concepts must supervene on the properties of the objective processor (the "brain"), which implies that the rules of operation of the latter must themselves be deductively intelligible. The things-in-themselves that manifest as experienced objects must also be deductively intelligible, or else they would require an arbitrary intervening mechanism to constrain the appearances to deductively intelligible rules.
40. If the emergence of deductive reasoning is immediately necessitated by the original existential context of the subject, then the meta-realm is necessarily a realm of things-in-themselves for the experienced phenomena. The meta-realm must contain distinct entities and deductively intelligible rules for their operation.
A subject acquires its rational self-consciousness in the original existential realm.
The original realm has all the properties in which rational self-consciousness can function properly.
Other experienced (subsequent) realms may or may not have the required properties for the proper functioning of rational self-consciousness.
The only way for the subject to test the fitness of its existential realm is by studying the observable phenomena.
41. Observable phenomena can be used to verify only the properties of the ideal original realm that reflects the appropriate meta-realm without distortion.

The meta-realm cannot produce the necessary emergence of deductive reasoning unless:
It contains a brain (or any suitable processing device) that enables thought.

1. Its laws are such as to constrain the governing processes of the brain to deductively intelligible operations, such as to translate into deductively intelligible sensations and experiences.
2. The objects are well defined such as to be correctly intelligible only in deductive terms, with distinct entities and causal mechanisms.
3. The fundamental (microscopic) processes are intelligible with the same concepts as the observable (macroscopic) processes.

A subject cannot know if it exists, as a matter of fact, in a realm that reflects the ideal original *meta*-realm.
A subject can determine if it exists in a realm that has all the properties of an original *existential* realm.
The original existential realm contains the properties, listed above, of the ideal meta-realm.
If the subject detects any violation of the required properties, then it cannot be in a realm that is consistent with the original realm.
In this case the experiences must be treated as unreliable, because they cannot be compatible with the emergence and (therefore) proper exercise of rational self-consciousness.

If all the required properties are confirmed beyond reasonable doubt, then the subject is in a reliable realm, because its properties are fully compatible with the proper operation of rational self-consciousness.
The rational subject is existentially subordinated to the appearances in the existential realm, which makes it inconsequential if the subject is not really in the original realm.
42. Once the fulfillment of all the necessary preconditions for the emergence of rational self-consciousness is confirmed, the existential realm is necessarily reliable.

This conclusion appears to solve the radical skepticism of Descartes, because the "evil demon" argument does not hold in the realm with observed ideal properties. (Of course, this depends on proof that a subject is, indeed, in a reliable realm). Also, it eliminates the skepticism of Hume, because some inferences are inseparable from the necessary existence of the thinking subject. In other words, Kant is back in the game. The only novelty of this argument is to show that transcendental idealism must be limited to existential realms with specified observable properties.

Problem:
At the macroscopic level of observation, we seem to detect the fulfillment of all the preconditions for rational self-consciousness. However, modern science tells us that the fundamental properties of matter are different. According to the preceding argument, elementary processes should not require different types of laws for their explanation in the ideal case. In order to address this problem, we need to know the prerequisites for rational self-consciousness at the microscopic levels of material organization. This is going to be done next, by attempting a reverse-engineering of the necessary mechanism for free will.

Part III

Free will implies the existence of objective (physical) phenomena, whose outcome is up to the subject. Its actual operation depends on two conditions:

1. The objective past of the process must be perfectly indeterminate. Out of several available outcomes, only one should be possible, but the history of the process is perfectly indeterminate as to which of them is actually going to take place.
2. The will of the subject is an independent faculty, which determines exactly the outcome of the objective indeterminate situation. This determination must be grounded on explicit motives, without being reducible in full to an objective state of the world.

The motives for free action cannot be reducible to a state of the world that is prior to the existence of the subject.
The subject must acquire these motives after the emergence of rational self-consciousness.
The operation of rational self-consciousness unfolds in a single temporal sequence.
43. The motivations for free action must be acquired in incremental steps, through a developmental process.

The motivations for action require an objective (physical) substratum for their existence. If the subject exists objectively, this part that represents the subject in its decision making must be objective too.
At the moment of choice, the motivations for action should be independent from the indeterminate process that must be resolved, or else the choice cannot be up to the subject (being reducible to external properties).
44. The mechanism that supports the existence of motivations for action must be objectively separated in full from the processes that must be resolved by the will of the subject.

The motivations for action must be independent from all other mental processes and experiences of the subject, but they must be relevant for the choices of the subject.
The motivations for action enter the awareness of the subject in small steps, as shown above.
Any free choice of the subject is not reducible to a purely physical phenomenon.
The reaction of the subject to the consequences of its own free choices is not reducible to a physical state of the existential realm. It could not be accounted for without the agency of the subject.
All other phenomena must be reducible to objective states of the existential realm of the subject.
45. The motivations for free action can only be grounded on the record of free choices of the subject, and the reactions of the subject to the consequences of its free actions.

The subject must begin the process of developing motivations for free actions from perfect ignorance (in order to satisfy conclusion 45).
In the absence of guiding principles, the motivations for actions can only develop arbitrarily.
The motivations for action should not be arbitrary, or else they do not represent the subject.
46. The subject must have an objective property that acts as a guiding principle (or filter) that shapes the development of motivations for action.

The guiding principle must be at work before the accumulation of any explicit motivation. It represents the nature of subject, independent of the states of awareness that are induced by experiences.
The guiding principle cannot be a product of the rationality of the subject.

47. The guiding principle can only be experienced after the fact, as a reaction to the consequences of an action.

In the absence of motivations for action, the subject must make indeterminate choices.
A choice that is informed by an explicit motivation is not arbitrary.
An explicit motivation can be obtained as a result of a reaction to a previous experience. The reaction is well-defined and the experience is well-defined.
If the experience was generated by a random prior choice, it is well-defined nonetheless.
48. Indeterminate choices are not arbitrary, if they are guided by well-defined principles, and are subordinated to non-arbitrary processes.

Explanation: The subject begins with no preferences. The initial choices are arbitrary, yet guided by the intention to study their effects, and to label them accordingly for future actions. These labels are stored in the independent memory bank that serves as a source of explicit motivation for future free action. A free choice is either determined exactly by well-defined motivations, or it is determined by provisional learning motivations. Both types of motivations represent the subject, and cannot be described as arbitrary. A subject is responsible for its actions because its Will makes the (metaphysical) choice over a physical configuration. The subject is the ultimate cause of the action, whether or not the motivation is well-defined or not. Even when the action is not determined by clear motivations, the subject still chooses which outcome should happen, except the motivation is provisional (to see if it works and to try something else next time if it does not).

A physical causal process can only be indeterminate if the totality of all material influences is insufficient to determine the final outcome.
A subject cannot exercise a determining influence on such a process with physical means, without violating the preceding requirement.
49. A free subject can only exercise its will with metaphysical means.

Further questions: How can this take place? What properties are required?

Free will can only operate in contexts that are compatible with its exercise.
Perfectly deterministic realms, in which objective laws account for every possible outcome, are not compatible with the exercise of free will.
50. The operation of free will requires existential realms in which objective laws are insufficient to determine each and every possible outcome.

Freedom must be not only possible, but also useful.
Decisions must be motivated by considerations about the experienced world.
Evaluation of future consequences of each course of action is necessary for proper decisions.
Such evaluation is impossible if the existential realm is not perfectly causal. The slightest deviation from causality can undermine the point of making a decision.
Actions are singular events. Probabilistic rules exclude the possibility of achieving intended goals for single decisions.
51. An existential realm that is appropriate for the exercise of free will must be perfectly intelligible and governed by (non-probabilistic) causal laws without exceptions.

Free will requires an existential realm in which physical laws are insufficient to determine all outcomes. (*cf.*50)
Free will requires an existential realm in which material laws are causal and work without exceptions, making all objective phenomena predictable. (*cf.* 51)
The islands of indeterminism, where subjectivity may enter as a causal factor, must be predictable in their emergence and parameters.
The opportunities for choice must be entirely constrained by material causes. No metaphysical influence can be exercised in contradiction to a physical law.
52. Free will requires an existential realm, in which the fundamental properties of matter are compatible with unfailing material causality, while allowing for external causality in objectively indeterminate contexts.
This is called "open determinism" in the text.

Ideal properties for free will are those which satisfy the requirement of intelligibility.
The fundamental objective properties must be intelligible with the same concepts that are essential for the rational self-consciousness of the subject.
The fundamental properties must be intelligible with the same concepts that are intuitively clear for any subject in the existential realm, in order to ensure that the realm is not designed to defeat the goals of the active subject.
53. Free will requires fundamental properties that are intelligible in terms of the same concepts that are appropriate and intuitively appealing for the description of macroscopic observations.

Objective laws must work without exception.
Yet, they must allow for islands of indeterminism, in which subjective causality can operate.
Fundamental laws must be intelligible and sufficient to enable the prediction of all types of observations.
If exceptional processes were allowed, the existential realm would not be experienced as coherent in all of its aspects, including its relationship with rationally self-conscious agents.
Fundamental objective properties must be configured such as to be compatible with subjective causality.
54. The potential for metaphysical causality in indeterminate contexts must be an omnipresent property, even though it can never become manifest in contradiction to physical causality.

Deterministic motion must include non-deterministic steps.
They cannot be consequential in deterministic contexts.
They should be consequential in non-deterministic contexts.
Omnipresent free motion implies that elementary entities should always have a choice between two or more steps.
The choice of each elementary step should not be determined by objective laws.
The types of choices that are available should be constrained by objective laws.
The exercise of free choice at the elementary level should not be consequential in any objectively deterministic process.
Unstable equilibriums in classical physics may have indeterminate outcomes.
Non-linear (chaotic) environments could amplify microscopic events in a macroscopically consequential way.
Classical physics is compatible with the requirements for rational self-consciousness.
55. Mechanisms for proper exceptions to physical causality, as required by free will, are possible.

Unstable equilibriums are very delicate configurations and happen rarely.
Every instance of degeneration of an unstable equilibrium destroys the context in which it occurs.
Rational self-consciousness requires a constant supply of free options.
The brain of a rationally self-conscious being must have a dedicated region in which perfect unstable equilibriums can be repeatedly created, shielded from external influences, and used as switches for alternative courses of action.
The potential for voluntarism, though omnipresent at the fundamental level of matter, can only become consistently manifest in appropriate complex contexts.
56. The potential for free will may be experienced as an exceptional property of rational beings, even if it was common to all microscopic entities of an existential realm.

Motion is the essential behavioral component of microscopic entities in a material environment.
In deductively intelligible contexts, the motion of macroscopic entities is produced by the motion of microscopic constituents.
External causality must result in changes of the pattern of motion.
If it was exercised over complex entities, the resulting pattern would not be reducible to microscopic causes. A contradiction with objective laws of motion would follow.
57. A material environment for free will must contain a primary level of matter with indivisible simple constituents.

Free will implies the power to produce exact outcomes for unstable equilibriums.
External causation must produce well-defined changes in the direction of motion of elementary entities.
Fundamentally continuous motion, following from a pre-existing cause, cannot be changed without violating its objective pattern.
Discontinuous motion resulting from voluntary discrete steps does not produce such difficulties.
58. Free will requires a fundamental level of matter with indivisible entities, moving in discrete voluntary steps.

Elementary motion must look predictable at macroscopic levels of analysis.
Elementary motion must be constrained to follow a constant number of steps in the same macroscopic direction, in order to conform to an objective process that can be experienced as continuous constant motion.
59. Macroscopic continuous motion must result from constrained microscopic choices (in space and time) exercised by discrete elementary entities.

Elementary discrete motion is intended to create opportunities for subjective causal influences.
This type of motion could either exist for arbitrary reasons, or as a necessary function of well-designed environment.
The markers for such motion are predictable only if it emerges as a necessary property of its environment.
Predictable elementary motion is rectilinear.
Microscopic obstacles prevent rectilinear motion. Entities in motion would have to go around them at every encounter.
Symmetric obstacles produce indifference in terms of the required effort to move around them. Yet, the entities must always end up along the rectilinear trajectory.
Macroscopically rectilinear motion in contexts with microscopic obstacles cannot be produced by externally determined patterns of motion. The cause of motion at each microscopic step must be "internal" to the elementary entity.

Motion is always relative. Elementary motion (for a single entity) can be described meaningfully as rectilinear only relative to a fixed medium.
Motion requires a fulcrum, which makes it necessary for the elementary entities to maintain contact with the solid medium.
Obstacles must be present with necessity if they help motion.
A fixed solid medium would prevent motion, requiring openings for the elementary entities to go through.
Obstacles must be avoided with necessity if they prevent motion. Openings in the medium could leave an elementary entity without fulcrum for continued motion.
60. Elementary voluntary motion would be a necessary property of contexts with discrete entities embedded in a solid media with symmetric void areas.

NB: An environment for voluntaristic elementary motion, suitable for free will, must contain indivisible entities engaged in indestructible motion. At the macroscopic level, this motion would appear continuous and rectilinear. At the microscopic level, the same motion would consist of discrete steps around void areas, such that every step is a choice among equivalent ways to cross the mentioned empty regions. Note that the elementary discrete motion *produces* the parameters of apparent macroscopic motion. Its predetermined and undetermined parameters are part of the same mechanism that produces the macroscopic observable pattern. When the undetermined aspects are revealed in non-linear equilibriums, there is no contradiction involved.

The stipulated properties of individual elementary entities must be preserved during their interactions.
If elementary entities were allowed to interact via direct collisions, the fundamental parameters of indestructible motion could not be preserved in a self-consistent manner.
The direction of motion and its other parameters would no longer be reducible to the effects of specified elementary steps.
Motion must always be reducible to the elementary properties, or else it cannot be preserved for the manifestation of free will.

If different entities were allowed to collide, their exact position would be relevant for the outcome of such interactions.
The freedom of elementary entities to have unconstrained choice among local alternatives would be undermined.
Exact influences on the elementary entities with subjective causes would not be possible with certainty.
61. Elementary entities must obey an exclusion principle, preventing any kind of direct contact between them.

The interaction of elementary entities must be mediated.
62. The solid medium for elementary motion must be elastic.
Elementary entities must behave like constant oscillators, producing waves with point-like sources at every step on the medium.
The mandatory minimum distance between any two entities and the details of their mediated interaction must be such as to exclude the possibility of macroscopic consequences from the degrees of freedom in the position of elementary entities.
Within such rules, elementary entities must have a constant effect on their medium, subjecting it to dynamic changes, and their interactions would consist in changes of their trajectory under the effect of the medium.

Summary: Elementary discrete entities must move in discrete steps on a solid elastic medium. By design, these entities would behave as if programmed to keep constant contact with the medium, and also to make fixed numbers of steps during constant units of time. Each step should involve a choice between two or more available positions. These choices must be arbitrary, but also inconsequential, because they cannot violate the macroscopic pattern of rectilinear motion. Moreover, different entities must only be allowed to interact through the effects of their waves on the medium.
In special environments, in which a macroscopic object is balanced on a point in space in some sort of unstable equilibrium, the same indestructible motion must cause the collapse of the arrangement in a physically undetermined way. Remarkably, this degeneration would not violate any conservation principle, including the conservation of energy, because indestructible motion would be the determining factor for all symmetries of such a universe.
63. Hence, it is possible to have unfailing material laws and the propensity for free will in the same environment, without any contradiction.

As a corollary of the above, some universes can be hospitable for the meaningful exercise of free will. Yet, necessary instantiations of such environments must contain several unmistakable physical properties, whenever its fundamental laws are mutually compatible without any contradiction.

1. The universe must have a fundamental level of material organization, which determines the properties of all macroscopic phenomena. This means that matter cannot be infinitely divisible in such contexts.
2. All entities must be discrete at the fundamental level, having constant and indestructible properties.
3. Fundamental interactions must be mediated.
4. The fundamental entities and processes must be well-defined and clearly intelligible in terms of macroscopic analogies, as seen by internal observers.

These are all properties that are experimentally verifiable, at least in principle. Therefore, the hypothesis of free will can be developed in a testable manner, even in the case of the most stringent model, as defined in this text.

NB: we do not know how the motivations of a subject influence the choices of elementary entities. We cannot verify this. We can only test the phenomenal part. Though, the phenomenal part is the only concern in this discussion, because the task is to validate the nature of appearances for their compatibility with rational self-consciousness. This demonstration has identified the observable properties that must be at work, if free will is to be possible.
Responsibility follows from the fact that the subject is the ultimate cause of the action, through non-physical causality. The choices are representative of the subject and not arbitrary, even though they are not reducible to objective states of the world that exclude the subject, because they follow the motivations that are obtained as described.
Note the difference between “ultimate cause”, and “could have done otherwise”. The first one comes from metaphysical causality. The second one describes the motivations and is not a threat to responsibility even if the motivations are well-defined and the subjected “could not have done otherwise”.

Part IV

Reliable existential realms were shown to have three necessary properties:
- Fundamental level of matter;
- Solid elastic medium;
- Indivisible elementary units, acting as sources of energy.

Basic matter
A fundamental level of matter is one that explains the properties of all superior levels of matter, and does not require another level of matter for the explanation of its properties.
The goal of scientific explanation is to find the cause of all variation of physical properties.
If there is no variation, there is nothing to explain that could have practical implications.
A level of material organization without diversity of physical properties does not require another structural level for its appropriate understanding.
64. A methodologically fundamental level of matter can only have one type of entities with a common set of properties.

In a perfectly causal Universe, the properties of complex entities are reducible to the properties of simple entities.
In a perfectly causal Universe, a single set of laws determine the behavior at all complex levels of organization.
In such a Universe without a fundamental level, there are no elementary entities.
A causal Universe without elementary entities is infinitely reducible to lower levels. It contains only complex levels of material organization.
65. A Universe, whose phenomena are governed by a single set of laws, cannot have a fundamental level of organization.

A causal Universe with more than one set of laws may or may not contain a fundamental level of matter.
A fundamental level of matter must have exceptional uniform properties.
These properties must be theory-independent, or else they would require another level of material organization for their explantion.
66. A causal Universe with a fundamental level of matter has a single set of laws for all complex levels of organization, and an exceptional set of constant and uniform theory-independent properties for the elementary entities.

The physical phenomena of our Universe require a single set of laws for all macroscopic levels of matter.
The microscopic phenomena of our Universe require special assumptions for their explanations.
The speed of light is theory-independent constant.
Planck's constant is a theory-independent value.
There are no reasons to rule out the validity of theory-independent constant parameters in our Universe
67. The properties of our Universe are compatible with the existence of a methodologically fundamental level of matter.

Mediation
Modern physics is believed to be incompatible with the hypothesis of mediation for two reasons:
1. The success of the theory of relativity.
2. The negative results of the Michelson-Morley experiment.

Mediation implies the reality of a preferred frame of reference.
Relativity is based on the non-existence of preferred frames of reference.
Human observations have not been capable to detect a preferred frame of reference.
If there was an all pervading universal medium, we would have been able to detect a preferred frame of reference.
68. Our Universe does not have a medium.

Counterargument:
Our expectations to observe a preferred frame of reference, given the existence of a fundamental medium, is based on our experience as external observers of elastic media.
For immersed observers, limited to the means of observations dictated by their context, such observations are impossible (cf. Bacelo and Jannes).
Given the success of relativity, the possibility of mediation does not require additional ontological assumptions.
69. Relativity is compatible with the reality of an all pervading elastic medium.

Light is possibly made of photons.
Photons are not necessarily waves.
If photons are not waves, the preceding counterargument has a loophole (a preferred frame should still be observable).
70. If so, the results of Michelson and Morley are relevant.

Michelson and Morley proved that the speed of light is invariant.
If light was a wave, its speed would not be invariant.
The speed of light is the speed of photons.
If photons are not waves, their speed invariance cannot rule out the existence of a medium.
The experiment of Michelson and Morley is only relevant if photons are not waves.
71. The experiment of Michelson and Morley cannot rule out the reality of an all pervading elastic medium.

Emergent free will requires a material context with discrete mobile entities, acting as source of waves.
Photons could be made of such entities.
Photons have wave-like properties.
The wave-like properties of light could emerge from the waves of elementary properties.
These waves should not be invariant, as assumed by Michelson and Morley.
Michelson and Morley may have tested the wrong phenomenon.
72. If photons are not waves, the reality of an all pervading medium is verifiable.

All wave-like properties of light are perfectly predicted by the Huygens Principle.
According to Huygens, every point on the front of a wave should be treated as a source of secondary waves.
In the case of macroscopic media, each molecule can be treated as a source of such secondary waves.
In the case of light, every sub-photonic propagating entity can be treated as source of secondary waves.
Secondary waves should become observable as static fields (electric or magnetic).
The speed of secondary waves should correspond to the speed of propagation of changes within static fields.
The speed of secondary waves cannot be equal to the speed of light.

The speed of secondary waves should be invariant.
73. The reality of an all pervading medium in our Universe can be verified by testing the speed of propagation of changes within static fields.

Wave sources
The spectrum of electromagnetic radiation must correspond to the low-frequency end of the Rayleigh-Jeans curve, up to the limit predicted by Wien's displacement law.
The best known way to predict this property is by taking into account the distribution of resonant modes inside a 3D cavity, under the assumption of quantization of energy.
If electromagnetic energy was made out of pure waves, it would lead to the UV catastrophe.
74. Electromagnetic energy cannot be constituted by pure waves, as understood by classical physics.

Planck suggested that light could still be a classical wave, if the shape of the spectrum during thermal equilibrium were induced by the measuring devices.
The UV catastrophe can only be avoided by limiting the amplitude of waves to discrete values, proportional to Planck's constant.
This limitation predicts the total distribution of energy.
If quantization were merely a measurement artifact, Wien's displacement law would be violated.
75. Quantization cannot be explained as a measurement artifact, without unusual supplementary assumptions.

Einstein suggested the photons as indivisible particles that make up electromagnetic radiation.
If the photons were indivisible, frequency conversion would be impossible.
If frequency conversion were not possible, thermal equilibrium distributions would be impossible.
If photons were simple particles, frequency would have no physical meaning, contrary to evidence.
Also, allowed frequency values are continuous.
If photons were indivisible, but surrounded by fields, the fixed unit of action cannot be explained.
76. Quantization of energy cannot be explained with indivisible photons, without conceptual difficulties.

The crucial element of Planck's discovery is the constant unit of action that currently bears his name.
The fundamental unit of action is the only one that has to be indivisible for this model to work, without conceptual difficulties.
If these units of action were produced by plain particles, their association into wave-packets, such as to predict the probability of each frequency mode, would be impossible (in a physically meaningful way).
The easiest way to predict the wave properties of energy, its quantization, and the distribution of the spectrum, is by assuming that identical elementary entities act as source of waves, whose action is equal to Planck's constant.
77. Discrete identical sources of waves are the best candidates for a coherent interpretation of the black-body spectrum with the concepts of classical physics.

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