Epistemology and Transformation of Knowledge in Global Age

Edited by Zlatan Delić

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Meet the editor

Zlatan Delić was born in 1965 in Sarajevo, Republic of Bosnia and Herzegovina. He has received his master's degree at the Faculty of Philosophy in Sarajevo. He has received his PhD degree at the Faculty of Political Science in Sarajevo. He has written over 20 scientific papers and many chapters in various books. His scientific interests in the past several years include sociology of knowledge, discursive foundations of ideology, social epistemology, post-war violence, victimology, and methodology. In the past couple of years, he has been in institutional analysis of discursive practices of public denial of the genocide that occurred during the Great War against Bosnia in the past decade of the twentieth century. He teaches courses from the field of sociology at the integrated University of Tuzla.

Contents

Preface

There is a certain consensus in history of science, and generally in history of mankind, that *knowledge* is one of those elements that affect society in some way. The dominant discourses about globalization have been developed about 30 years ago, right after we started speaking about the new, salvation era—about a global society of knowledge and information. After 2008—and after a complete defeat of mathematics models and methodology of economics—there came a global shock of which social consequences we are not adequately aware of. Let's move onto the global epistemological situation, if such a thing even exists. The sense and meaning of each term relating to globalization have been significantly shaken, and the new knowledge economics that has been (successfully) claiming that it was founded on knowledge has been shown as a dangerous deceit. That economics is leaning onto the Western concept of knowledge and rationalistic—utilitarian—military model of development that is deeply connected to colonialism and imperialism on the inside. In the past years, there were quickly developing new cognitive sciences connected to robotics and the new tele-techno-sciences from which we were searching salvation. However, the problem is in the fact that these new forms of knowledge manufacture may be fostered and manufactured into new forms of social inequalities. We often do not see them or do not understand them in a correct way because we are living on the edge of chaos or on the edge of "extraordinary state" (if we are really "unlucky," then in the middle of "global extraordinary state") that transforms into an integral spectacle of the new totalitarian era. That is the era that has no foundation except for violence and mutually fulfilling types and forms of terror. That is the era that, most probably, we could not be able to classify or understand without repeating and slow reading of Michel Foucault, the French philosopher and sociologist. Foucault was among the first who discovered how *power structures* shape knowledge and how certain *knowledge structures* support hierarchies of power. Namely, he claimed how each epoch (era) is marked with the leading *episteme* (knowledge or form of knowledge). This *leading understanding structure* (or "discourse") determines what could be known in a given socially historic context. Therefore, exactly this leading understanding structure—which is expressed with the help of privileged terminology at some point of time—finally determines what is accepted as "true" or "real," and what is lost, repressed, erased, marginalized, or simply vanished as "mythical" or "made up." Finally, who decides about *what knowledge is* and who knows *what needs to be decided* in things relating to knowledge when these things are unclear? Who decides about ways of educating terms, concepts, and terminology? Who decides about knowledge, at the moment when the greatest parts of global public stop believing in a certain orthodoxy?

Some epistemologists believe that beliefs, which in certain time seem unbearable, in just one moment of some other time may be bearable. However, how come we may speak of knowl-

edge in the twenty-first century when it became obvious that all terms that are inherited from the twentieth century have become "zombie" categories, empty markers that refer to own emptiness. The rest of the twenty-first century could therefore remain in the sign of epistemology of virtue and in the sign of socially epistemological battle regarding meaning.

At the end of the second decade of the twenty-first century, we remember *the great promise of globalization*—promise about creation of a "unique world without borders." This promise, about 30 years ago—in the time of ruining the Berlin wall—was given in the name of "freedom of markets." If it was truly about a promise—and it probably was—and if we may speak of a *broken promise* today, as believed by John Ralston Saul (in his book *Collapse of Globalism and the Reinvention of the World*, Penguin Canada, 2009), then we may ask a question: in what name was the promise actually given? Not only the future directions to understand economics, politics, and society, but also the future directions of development of social sciences and humanities will depend on the manner in which this question is answered. Shortly, the western project of modernity and neoliberal globalization should be faced with *blind flaws* of the instrumentally utilitarian rationality and epistemology, but also without prying into pseudoscience or united irrationalism of religious revivalism and ethnic monocentrism. In a long period from the time of the occurrence of antic *epistemology of virtue* until today, epistemology has gone through a long and exhausting path. Epistemology of virtue, as we know, personifies the "unfortunate" character of Socrates while humoring the look of the new economics of knowledge, and quality is ensured by the executive "character of satisfied customer," that is, *biopolitics of mandatory satisfaction* (Costas Douzinas). Biopolitics of mandatory satisfaction functions as an integral part of neoliberal globalization of the world. And, this is the concept, according to some, that decomposes before our eyes, especially, if it is true that western cosmopolitism ends with the imperialism of market. Sociologists such as Douzinas believe that we should go back to the beginning, to the Mediterranean. It is about going back to ontology of a singular equality and culture of hospitality and openness. Today, neutralization of economics marks the end of politics and idea of Europe. Universality assumes mutual world of meaning and value, a mutual horizon that includes our different worlds. The answer to European crises lies in a transcendental community, subjectivity of one universal *we* for which Europe is name and mission, as written by Douzinas in *Philosophy and Resistance in the Crisis*.

Finally, this book may not be a replacement for understanding reasons for the occurrence of epistemological discontinuity in historical flows of occurrence of epistemological ideas. It searches for theoretical, conceptual approaches with which it would be possible to scientifically and responsibly explain the "state of knowledge" in the global era. It represents the result of great intellectual effort of scientists that deal with epistemology and the consequences that the global transformation of knowledge has on our lives. The authors construe contexts in which they question mystery, historical openness, and multitude of possible worlds of knowledge. Each chapter may be read also as the unique resistance against orthodoxy that bites into the idea of knowledge as well as geo-epistemologically challenging adventure "without limits." We mutually search for at least one epistemologically significant sentence that may help us overcome the bewitched circle of wrong visions of transformation of knowledge acting right before our eyes. The book does not offer any definitive answers. Before, we may say that it rehabilitates inside logics of mutual conditionality of questions and answers, leading us to new question in epistemologies of certain types of knowledge in the visible or the invisible.

In order to warm up for epistemological puzzles about the meaning of perception, we could maybe repeat the words of Nelson Goodman, written in the book *Ways of Worldmaking*, in the chapter "A Puzzle about Perception: Seeing beyond Being." Once in awhile, someone asks me rather petulantly "Can't you see what's before you? Well, yes and no. I see people, chairs, papers, and books that are before me and also colors, shapes, and patterns that are before me. But do I see the molecules, electrons, and infrared light that are also before me? And do I see this state, or the United States, or the universe? I see only parts of the latter comprehensive entities, indeed, but then I also see only parts of the people, chairs, etc. And if I see a book, and it is a mess of molecules, then do I not see a mess of molecules? But, on the other hand, can I see a mess of molecules without seeing any of them? If I cannot be said to see a mess of molecules because "mess of molecules" is a sophisticated way of describing what I see, not arrived at by any simple look, then how could I be said to see a magnet or a poisonous mushroom? Suppose someone asks whether I saw the football coach at my lecture, and I say "No." But he was there in the audience, and I surely saw everyone in the audience. Although I saw him, I say I didn't, because I didn't know that the man at the right end of the eighth row center was the football coach. Already, we are in danger of losing ourselves in an all-too-familiar tangle of not-too-dear questions. You will be glad to hear, and I am even gladder to say that I shall not be dealing with such questions about seeing or not seeing what is before us but rather with some cases of seeing what is not before us."

Epistemological puzzles of perception of the world probably belong within the most important marginal questions we may ask. They relate to margins of our knowledge within ourselves and our human world, which in theory exists only as one within infinitely many other possible (better or worse) ones different from this one that we perceive as the actual one.

I owe immense gratitude and sincere congratulations to the authors of all chapters for genuinely valuable chapters. I am grateful to anonymous reviewers of all chapters for useful remarks and suggestions. Without the technical help and kind support of the Publishing Process Managers, Iva Lipovic, Mr. Edi Lipovic, and other InTech associates, not one of these chapters in this book would be finished. I am grateful to my friend Sanja Petrovic Delic for her expert support during the translation of these texts. Still, the greatest gratitude goes to my family, my wife Adisa and my daughter Ilma. I take the greatest responsibility for all imperfections in the text.

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Introductory Chapter: Sociology of Knowledge and Epistemological Paradox of Globalization

Zlatan Delić

Additional information is available at the end of the chapter

1. Introduction

Sociology of knowledge constituted, as an extremely reflective field of knowledge research, in the first half of the twentieth century.[1] However, all the way until the first decade of the twenty-first century, it has been unclear what really makes the specific problems of sociology of knowledge. Sociology of knowledge is also neglected today, in the first half of the twenty-first century. But why is that? We should be careful of simplified answers, however, for easier resolution of the meaning of the upcoming text; we should use some categorical, constative statements. To make it simple, we are in the *anti-epistemological* situation because this situation is not shaped by epistemology, but rather it is shaped by the new knowledge economics as a false replacement for epistemology. In such situation, it is hard to find vocabulary in which it would be possible to ask adequate questions relating to that situation, and it is even

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[1] It is believed that the founder of sociology of knowledge is Karl Mannheim. After the translation of his capital work *Ideologie und Utopie* to English, there were fruitful assumptions for critical research of knowledge made, in the fields of new sociology of knowledge, sociology of ideology, sociology of science and technology, epistemology of science, social epistemology, epistemology of economics, epistemology of legal sciences, epistemology of mathematics, and so on. However, it seems that not even in the twenty-first century epistemological situation in social sciences and scientific research in general (that was, say, according to the thinking of "theorists of addiction" catastrophic) was not recognized as a foundational problem of the survival of mankind. However, as we will see in the last pages of this chapter—and further—it seems that the epistemological situation is gradually changing because we are searching for new epistemological communities. In the twenty-first century, fields such as sociology of knowledge, social epistemology, and epistemology of social sciences are truly becoming interesting interference fields for many marginalized researches from "undeveloped countries" and "developing countries." For many researchers who deal with paradoxes of development, paradoxes of economic globalization, and such—that is, asymmetrical development of whole continents, regions, and zones—social sciences are found in an epochal milestone. They are found on a milestone for many scientists, scientific rookies, researchers, activists who deal with questions of epistemological colonialism, cultural imperialism, inside colonialism, racism, discrimination, post-colonial studies of science and technology, not only in Latin America, Asia, Africa, but throughout epistemic-free areas of knowledge that search for emancipated intellectual areas in which genuine cosmopolitan conversation of mankind would be possible.

harder to think that we could offer or even have answers that would be operative in education or some other practice. According to the warnings of many specialists from the field of education theory, already in the progressivist vocabulary, which we use when we talk about development, we may observe the anti-epistemological, anti-educational trends. Trends that speak of unlimited, linear progress, growth, and development simply are not correct. The remainder of this chapter has a task to explain, at least in short bullets, how it is possible that thorough disciplines, which were responsible for studying social conditions of knowledge by their vocation, all the way up to the second half of the twenty-first century, did not make a more significant cognitive impact on the society itself. Simply said, epistemology of science, sociology of knowledge, sociology of science, technology and education, as well as other critical and reflective disciplines that process knowledge and education, are truly neglected. Instead of those disciplines, the main word in the knowledge things is already led by the so-called the new knowledge economics. With the help of financial institutions, institutions of subtle and less subtle supervision and control, with the help of administrative bureaucratic procedures of evaluation and self-evaluation of study programs, which must be written in the new economics, progressivist language of management and marketing, the new economics of knowledge (and skills) has successfully colonized, hegemonized, oppressed, and completely erased the emancipated vocabularies and emancipated potentials of social sciences. Critical social sciences are, with the excuse that higher education must be *"adapted to the market needs"*, placed in a humiliating position—a position of slaves of the neoliberal ideology.

2. Marginalization of sociology of knowledge as a symptom of epistemological crisis of science in the age of postglobalism

The main reason for marginalization of sociology of knowledge, and fields of research related to it, is that the *subject field* of research of social sciences (and this is the *global society*) is completely colonized by the progressivist ideology and vocabulary of the new knowledge economics. This is the *symptom of epochal epistemological crisis of social sciences in the twenty-first century*. This chapter searches for at least one sentence in which it would be possible to pledge for creation of new *intellectual areas* in which it is possible to speak about complex relations, in an alternative way, between *knowledge-science-education-development-ideology-new media environment and living environments*. In her book, Connected Sociologies, Gurminder K. Bhambra follows the critical tradition of Wright Mills and Alvin W. Gouldner, and she persuasively criticizes Ulrich Beck, Michael Mann, and Immanuel Wallerstein. The final result of the works of these authors have been famous because of their criticism toward dominant systems of knowledge in the West, Bhambra recognized in the impossibility that these authors—such great and significant critics of the West paradigms of development—throw away their prints (conceptual blueprints) of *Eurocentrism*. Bhambra suggests creating connected sociologies. Those would be sociologies that could preserve *pluralism* of local experiences. Without a thorough read, and special sensibility for injustice, we should not think that it could be crystal clear to us in which way these local connections, only on the grounds of local experiences and intellectual experience of the postcolonial studies, but without some greater institutional

and symbolic noble power, could or should correct the multi-century discursive domination of main flows of social theory. In order for these local connections, local fields of knowledge could impact the future directions of development of *sociology of globalization*. This still remains to be seen. In every case, it seems that one such book still, in some way, outlines new ways of understanding global society and offers hope in the future of social sciences, as Raewyn Connell states. However, what do we do with the new economics of knowledge and information in global society of knowledge, if the global knowledge society threatens to turn into global society of asymmetrical supervision on production and reproduction of knowledge and information? The problem of justification or self-legitimization of what is called the "new knowledge economics" consists of the fact that the new knowledge economics has an institutional power and forceful *administrative-political* and *supervisory* means, with which we may state that it is based on knowledge, without any scientific or logical evidence for such statement.

Since sociology of knowledge has been neglected in the main flows of social sciences until the second half of the twenty-first century, it did not, even later with the flare of "globalization," have a greater institutional or cognitive impact on educational processes and processes of internal or external evaluation or self-evaluation of those processes that were conducted under the trademark of new knowledge economics that should have been the foundation on which free and prosperous *global society of knowledge* is built. It is devastating that the interconnected field of knowledge, such as philosophy of science, epistemology of social sciences, social epistemology, sociology of knowledge, sociology of science and technology, sociology of information society and cyber culture, and so on could not have a significant impact on newer reforms of high and higher education. Therefore, simply said, even sociology of knowledge, as many other close critical researches on science and ideology, could not have almost any impact on *theoretical and methodological trends* and movements in economy, society, politics, and such. Under the general term *sociology of knowledge*, we may find very important groups of synchronic and diachronic connected topic, intellectual impacts from the past and highly demanding symbolic interactions between different, older and newer, research fields that deal with *theories and practices of knowledge*. Or, even with corporative use or misuse of what may be called "knowledge," in any communication-clear context of epistemic discussion, through justified or unjustified faith or belief. It is therefore possible to differentiate classical sociology of knowledge, founded by Kall Mannheim, in the first half of the twentieth century, and the *new sociology of knowledge*, which is primarily connected with the *sociology of globalization*.[2] However, both classical and new sociology of knowledge are closely related on mutually unclassified fields of critical reflection which may be conducted in a sign of philosophy of social sciences, social epistemology, or something similar.

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[2]Sociology of globalization leans on the tradition of Western rationalist philosophy and, consequentially, on the linear, progressivist understood conception of development. The main concepts of globalization are thought of in the West, with the goal for their use as the universal order of words and things. That is, before all, a symbolic order of discourse that is euphemistically named global society of knowledge (skills, information, and such). The problem (not challenge) is that the Western concepts of globalization are only ostensibly pluralist and only ostensibly pluri-perspectivist. They are founded on a diabolic heritage of scientific rationalism, individualism, comodification, hedonism, epistemic progressivism, techno-centrism, technophilia, total management, militarism, rigmarole, consumerism, economist application of the idea of freedom, and ideologically applied (in fact discriminated) concept of human rights.

3. Sociology of knowledge and paradox of development in an approach of "new knowledge economics"

At the end of the second decade of the twenty-first century in philosophy and epistemology of social sciences, in sociology of knowledge, in social epistemology, and especially in economics theories and *politics of development* (in their immanent logics of measuring development), as well as in logics of synchronic and diachronic classification of social and economic reality in which we live in, we are missing an *adequate concept of knowledge* and *what we actually mean by development*—"Development," which would be worthy of that name. Knowledge is better than ignorance and, it is assumed, that knowledge is developing. It is assumed that in this way the general knowledge on *meaning* of the concept of *knowledge* itself is developed, as the knowledge of the meaning of *development* is developed. That is, we should become subject to an equal cosmopolitan discussion led between equally communicating individuals—members of epistemological community of the global society of knowledge. Progress, growth, and development are truly wonder words of the West Enlightenment and rationalism. To many, they are weird, tragicomic, obscure, sensitive, symptomatic, slippery, and such. However, indeed, those are the key determinants of privileged explanation of modern "progress"— progress that leads to economic and financial globalization and to globalization of knowledge as such. But, what is knowledge indeed? Is it maybe some fashion such as "Eurosong"? Or, should such question be understood, evaluated, and disregarded simply as wrong, as wrongly asked question? Who decided about *what knowledge is*, and who knows *what should be decided* when defining differences between knowledge and justified or unjustified belief? Is all knowledge equal? In what relationship are theory of knowledge and practice of application of knowledge? In what relationship are theory and practice (and theory of practice)? How do knowledge and power, knowledge and ideology mutually function? There are no simple answers to these questions, as there are no simple answers to question of globalization being a Western project. Where is the West? "It is not clear to me. In all parts of the world there is a place where the Sun comes up and the opposite, where the Sun comes down. If we are in Tokyo, for example, Beijing is west, where the Sun comes down, therefore in the West [1]" Economists, who believe in the neoliberal economics, as the new knowledge economics, are mostly pragmatic, especially in the twenty-first century. They did not overwork themselves thinking about overly hard socially epistemological, methodological, and geo-epistemological questions about relationships between knowledge and power. They were not writing for an overly long period of time, such as Spinoza, about relationships between theology and ethics. They did not exhaust themselves with figuring out puzzles about scientism, quantophrenia, and qualitative methodology. They actually used the time after the philosophers made an early pronunciation of "the death of philosophy," and then they successfully invented lucrative phrase "new economics of knowledge and skills" and placed it in drive, in the market where only the strong ones win. They have placed that phrase in the duty of economics and "social construction of reality." Economics practitioners, and even economics who lecture economics as a science (subjects from the field of social sciences), tried to *neutralize* as much as possible, to infinitely mathematize the subject (object) of economics, even though it should

be clear to everyone that economics is a social, and not a natural science.[3] In such a way, they have shown that they are working on an *epistemologically slippery field*—in the middle of a growing chasm—a chasm that is growing between economics theory, practice, and politics. This enabled them to completely neglect the epistemological and methodological assumptions of own "scientific" impact acting as if the epistemological and socially epistemological problems in economics theory, practice, and politics do not even exist. Economists and *militant ideologists of progress* have adopted the word *knowledge* and announced it (privileged) ownership of the new economics of knowledge (and information). Economic entrepreneurs of knowledge took the concept of knowledge in their own hands and announced it their own asset, a resource rather, on which the new knowledge economics decides. In this way, the knowledge is reduced to only one dimension, the economic one. Only one, significantly limited view of knowledge, is announced as a universal foundation upon which should be built a building of the global society of knowledge. They have cunningly announced how we are living—that is, how we should live—in the global society of knowledge and skill. One such diagnosis has become so generally accepted, so that every criticism of the new knowledge of economics today risks of being announced subversive, that is, dangerous for the reproduction of the dominant regime of knowledge.

If we go back to past, we also may speak of marginalization of sociology of knowledge. Even after Louis Wirth and Edward Shils translated Mannheim's *Ideology and Utopia: An Introduction to the Sociology of Knowledge*, sociology of knowledge in USA carried a stigma of over abstractness, impracticality, and burden of the philosophical—hermeneutic—epistemological reflection and relativism. Conceptual schemes of sociology of knowledge were burdened with theory, abstract, overly fluid, and reflexive. They were not possible to be directly applied in research or business practice. It seems that such books were not of any use, and this opinion still reigns even after 2008, even though it is obvious that economics was found in a collapse. It was like that even earlier, for many decision makers in higher education institutions and universities. It seemed that philosophical and sociological books, which study and research socially epistemological and methodological foundations of what we call knowledge in various contexts, were not necessary. Books on knowledge, written by sociologists of knowledge, such as Mannheim, could not have had a ready answer to the universal question of what

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[3]In this way, they showed that they are working on an epistemologically slippery field—in the midst of a growing chasm—a chasm that grows between economic theory, practice, and politics. Economists, with the help of new knowledge economics, construed a pragmatic, operative difference between the term know and skill know-how. This enabled them to completely neglect the epistemological and methodological assumptions of own "scientific" action, acting as if epistemological and socially epistemological problems in economic theory, practice, and politics do not even exist. Economists and military ideologist of progress have adopted the word knowledge and announced it (privileged), and ownership of the new economics of knowledge (and information). Economic entrepreneurs of knowledge have taken the term knowledge in their own hands and announced it their own, that is, a resource, about which the new knowledge economics decides. In this way, knowledge is reduced to only one dimension, the economics one. Only one significantly limited view of knowledge is announced as the universal foundation upon which we could and should build the building of the global society of knowledge. They cunningly announced the way we live—that is, the way we should live—in the global society of knowledge and skill. One such diagnosis has become generally accepted that even today, each criticism of the new knowledge economics risks of being announced subversive, that is, dangerous to the reproduction of the dominant regime of knowledge.

knowledge is before time, and this was evident in the way of asking questions as well as the way of searching for answers. This is why neither the sociology of knowledge in the twentieth century nor the epistemology of globalization could have been forced as a socially impacting intellectual field, even though, in nature of asked questions, they deal with dynamic questioning of the meaning of knowledge in the social context.

As Florian Znaniecki tried to explain later on, sociology of knowledge is not a "sociological theory of knowledge," because, in that case, sociology could have been found in an unusual position. As a theory of knowledge, "the science of other sciences" must have determined its own character in sociology, while it, as sociology, would determine its own character as "the science of all sciences." Naming these subtle differences, Znaniecki (See Ref. [2]) believed that in a non-problematic way, he could clear position of sociology of knowledge in a becoming society. However, since the 1980s and 1990s of the twentieth century, that is, since the time when *hyperinflation of shallow writing on globalization* came into place, it has become very clear that the so-called global society of knowledge does not favor *criticism, doubt*, nor asking *new sociological and epistemological questions* about foundation upon which the building of the *new knowledge economics* is built. Znaniecki wrongly believed that there is no need to argue about the word knowledge. He stated that many arguments could have been avoided if we had completely formed "science about knowledge." However, it is impossible to establish a universal science about knowledge. This is why the new knowledge economics, always and in every place where it wants to pretend in a universal character of its limited discourse about knowledge, transforms into quasi-sciences, which has the power of competition with definitions of knowledge just because it in itself represents a result of symbolic and real domination of the neoliberal ideology of global capitalism. We are surely talking about a globally forced quasi-science, the new economics of knowledge, skills, information, and such.[4] This is an approach that, with the help of the world financial institutions and Western educational institutions, was placed as a *universal science*, as the *science of all sciences*, and as a fundamental social ontology of the twenty-first century that has, almost unnoticed, encased into the structure of language itself, into the vocabulary we use to explain the world we live in. The new knowledge economics is, in fact, a "modern success story." This is how, in an unbreakable semantic relationship with management and manufacturing of knowledge, a great guru Peter Drucker has cunningly/lucratively marked it in his wrongly titled work *Post-Capitalist Society*.[5] In the chapter, *The Third World*, the author writes: "This book focuses on the developed countries – on Europe, on the United States and Canada, on Japan and the newly developed countries of the 'Third World'. This is not because I consider the less-developed nations unimportant or even less important. That would be folly. Finally, two thirds of the global population lives in the third world, and until the time when the present

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[4]It is an approach that, with the help of world financial institutions and Western education institutions, forces as the universal science, the science of all sciences. As a fundamental social ontology of the twenty-first century, that has, almost without notice, snuck in the narrative structure of language, in the vocabulary by which we explain the changes and the world we live in.

[5]In the first chapter, under the title "From Capitalism to Society of Knowledge," Drucker writes: Today, knowledge relates to and is applied only to knowledge itself. It is the revolution of management. Knowledge, today, quickly becomes an exclusive factor of manufacturing, pushing aside both capital and labor force. It may be too early (and definitely forced) to call our society the "society of knowledge"; for now, we only have the economics of knowledge. However, our society is surely post-capitalist….. This transformation is surely become a radical change in the meaning of knowledge.

period of transitions comes to an end (about 2010 or 2020), the third world will be home to a three quarters of the population. However, I also believe that is very probable that during the next decade or two, there will be the new and startling 'economic miracles' where the poor and fallen behind countries of the world are being transformed, literally over night, into economic forces that are recording growth. It is even possible, Drucker claimed then, that it would be far more of such transformations that there were in the last 40 years or so, since when we first started to talk about *social growth* [3]" It was necessary to include this long citation because of what we will mention in the main part of this chapter in the context of an opposing thesis: a thesis that the neoliberal conception of development, from start until today, was wrong, in order for it to finally transform into one of the most dangerous ideologies of the twenty-first century.

Drucker's words are an educative paradox about globalization and we cited them in order to emphasize one *enormous discrepancy*: a discrepancy between the *Great promise* (expressed by the great guru, founder of management) and the *Great disappointment*. Disappointment for what was *happening*, not only in the Third world but worldwide, since 1993 (when *Post-capitalist Society* was published) and until today. In more recent times, the doubt in the *Great promise* given during the 1990s has grown. The doubt is in the promise that we will, as mankind, in the limitless global world, and on foundations of the new cognitive economics based on knowledge (and only knowledge), soon step into the global society of knowledge and information where we will finally all be happy and satisfied because we live in a unique world with no limits, "most beautiful of all possible worlds."

Georges Gurvitch, in one text from 1971 [4], has expressed a belief that it could come as occurrence of other forms and types of knowledge in the future. He was right. That is why he stated that we cannot start our research of concrete relationships (regardless of whether it is about manifesting sociality, certain groups, groups of such groups in countries and churches, social classes, or global societies of different types) unless we take primarily more precise and more detailed analyses of knowledge types and their connections with forms of knowledge. Even though the sentence above sounds very abstract, I believe that it is useful to remind ourselves how classical sociologists seriously approached the topic of *knowledge*. On the contrary, from economists, for example, who were talking about the *new knowledge economics* or about the *global society of knowledge and skills*, and almost never, at least to my knowledge, showed the need to previously define own epistemological and methodological assumptions, or to explain what they actually think with the term knowledge. On the contrary to that, Gurvitch shows special caution for the use of terms. He believes that certain types of knowledge, especially the perceptual knowledge about the outside world, as well as knowledge about the *Second* and about the *We*, about groups, classes and so on, political knowledge, certain groups of expert knowledge that came out of natural sciences (astronomy, physics, biology, and such) or humanities (including history and sociology), require studying specific space and time in which the study objects are moving.

Neoliberal spaces of knowledge as well as neoliberal politics of knowledge and truth are using colonial logics of "free market" and anti-epistemological systems of knowledge that are totally destructive for human beings and nature. Neoliberalism transforms ideas of freedom, democracy, and education reducing them actually only to neoliberal economics. For human

beings to be able to live together, and in peace, with other human beings, it is necessary to educate ideas, concepts, and terminology in which it is possible to differentiate relations *science-knowledge-education-society-rest of the world*. Neoliberal knowledge economics represents an anti-educational concept, in which it is not possible to educate concepts about ourselves and our world, nor it is possible, in the frame of the language of the new knowledge economics, to truly make freedom serious as well as true potentials of a man as a citizen of the world. From that, there is a foundational tension between philosophy of social sciences, sociology of knowledge, social epistemology (pluralist and anti-colonial approaches), and the new knowledge economics. The new knowledge economics has put itself in a privileged epistemological position. The new knowledge economics thesis states that only neoliberal economics based on knowledge, technologies, and information may lead to creation of the global society of knowledge.

There are many ways in which neoliberal paradigm of globalization and the "new knowledge economics" serve as a quasi-epistemological basis for creation of the so-called global society of knowledge—impacts not only the spreading of neoliberal ideology in the field of social sciences but also education in mathematics, science, and technology in undeveloped countries. Paul Ernesto, from Exeter University, believes that dominant effects, achieved through ways in which research institutions, organizations, and scientific publications from Northern and "developed" countries, usually Anglophonic, dominate the international research community and education, are multiple, but they are economic and ideological before all. It is basic that there is export of university education from Western countries into Eastern countries and "developing countries." There is an *asymmetrical* economic effect, that is, *asymmetrical* inflow of knowledge and specialty to "developing countries." With that, there is a certain *ideological* effect. What is called an ideological effect is seen in that the *import* (that is) *export* of knowledge, skills, specialties, and research methodologies always also follows a set of implicit values, along with epistemological and ideological orientations. There is an international regulation (and promotion and marketing) of products of educational research through international bodies, conferences, and related publications.

In mathematical education, there are international coordination bodies, such as the International Commission on Mathematical Instructions (2001) that organizes conferences and study project, including organizations ICME, PME, HPM, organizations IOWME and conferences, and independent series of conferences (e.g., MES, ALM, and CERME) that gather researchers from many countries. An asymmetrical economic effect, Ernesto claims, does not represent a surprise. We may agree with such an opinion. An asymmetrical economic effect does not represent a surprise because we are used to living in a deeply unfair ideological world. We are probably used to living in such a world because we got used to that it is normal that the new knowledge economics (by definition) is based on trade of goods and sales of knowledge. Western and "developed" countries, in this way, may dominate manufacturing and guarantee (warranty) of knowledge of high value. They achieve that through control of highly prestigious publications and conferences and through forced Eurocentric epistemologies, Eurocentric methodology, and standards. Standards perform the function of insurance and keepers of those values through forced educational practices of their application. Such kind of "distorted trade," as it

would be called by a French philosopher and sociologist of media, Jean Baudrillard, always and again leads to an ideological effect. Ernesto, therefore, truly masterfully observes how researchers in developing countries internationalize ideological and epistemological assumptions and values of such dominant research culture. Further, "drain of brains" from undeveloped and poor countries into developed countries is used for recruiting talented migrants. Such individuals simply cannot resist accepting good working conditions and good conditions of intellectual development that do not exist in undeveloped nor developing countries [5]. In this way, developed countries, through exploitation of position of undeveloped countries, are ensuring assumptions for own economic progress. Globalization, consumerism, and ideology are all parts of the same semiotic system—system that does not acknowledge epistemic *limitations of growth*. Without consumerism, as a universal secular religion, ideology, and pathology, globalization would be impossible. Without globalization, as an ideology and religion of a consumer society, pathology of consumerism would not be possible.

4. Sociology of knowledge and vocabulary for the new era

The first decade of the twenty-first century has unwound in the sign of a dominant discourse about globalization. There were different discussions led on that topic, all until we started talking about "postglobalism" and the collapse of the neoliberal globalization of the world. The feeling of collapse has been emphasized after 2008, when there was an economic-financial crisis that shook the trust in the "new knowledge economics." For that new insightful economics, that stated for itself that it was based on knowledge, it was believed that—with the help of technology, new media, and mathematical models of explication of its explanations—it may function as an inviolable cognitive foundation and an instrument for creation of the global society of knowledge. However, this has been shown as an illusion. Even though through main flows of opinion in the West, the new economics was represented as a saving solution that (apparently) ensures the future of mankind, the crisis has destroyed a significant part of earlier economic-deterministic dreams. The phrase, which is the new knowledge economics that we keep repeating very often on purpose, is often expressed as self-understanding. This is because a great number of people believe that economic knowledge is important for the whole world and not just for narrow groups of economics students. It would be hard, except in an ironic way, to dispute the statement that knowledge is more valuable and more important of ignorance. It is believed that scientific knowledge is more superior to other forms or types of knowledge. Science is a valuable social activity because it represents the result of the intellectual, theoretical, practical, and research work of many individual scientist and scientist teams in time and space. Time and space of their work may be named on the foundation of various *mechanisms of differentiation* which do not have to be *purely* scientific, because there is no such thing as *pure* science. Also, we should warn about the danger of anti-science. In the second decade of the twenty-first century, the most different anti-scientific and populists movements are thriving. The best way to defend against populism should be critically oriented science and social epistemologies of individual sciences in the context of understanding true problems of development.

What can we even think about and in which categories of patterns do we think in? If we think in progressivist, techno-scientific categories of progress, growth, and development, it is clear that we think in globally privileged categories of the "new knowledge economics." Exactly because of this progressivist, privileged character of the new-economic vocabulary—which is recycled in the same intensity even after 2008—it has been shown that it is almost impossible to criticize the Bologna reform of education. Just as every criticism of the Bologna reform of higher education is turned against the one making it (as shown by Konrad-Paul Liessmann in *Theorie der Unbildung: Die Irrtümer der Wissensgesellschaft* [6])—similarly—everyone who dares to criticize the new-economic concept of development is exposed to the risk of being accused of anti-science (or even something more dangerous). This is why it is necessary to not give up from the task of manufacturing of *cosmopolitan public knowledge* about positive and negative dimensions of global development. It is necessary to search for *new intellectual areas of knowledge* in the context of application of epistemology of reflective rationalism (at the same time connecting global, regional, and local knowledge and experiences of the world). This means that it is necessary to epistemologically unite all epistemic units in genuine areas of knowledge. However, this union could only occur from one (still inadequately justified) unconditional respect of orders for *universal responsibility*. This knowledge should occur from responsible search for those knowledges about globalization that would, from its inside order for *truth*, come to *true knowledge*—knowledge that would indeed be worthy of that name. Craig Calhoun and Michel Wieviorka write: "If researchers in social sciences, regardless of their numerous differences, should unite, what could be the purpose of their engagement? What would be the reason of such worth for them to flow in to those risks? The answer is simple, at least in theory. This purpose and reason are concerned with the truth itself, truth about social life. This seemingly innocent answer is not at all fashionable, and still, it is about truth. It is never certain, it can always variate depending on accepted perspective, and it could be expressed through many different shades, in many different languages. Even though, it is legitimate to criticize the pretention for absolute truth, we cannot doubt the important significance of infinite search for fair understanding and well justified insight. [7]"

Wiebke Keim, Ercüment Çelik, Christian Ersche, and Veronika Wöhrer deal with the manufacture of world knowledge. Those who are excluded are humiliated. They give special attention to theoretical and epistemological reconfiguration of social scientists and humanities in the light of postcolonial criticism of knowledge. At the same time, they also provide a strong criticism of Eurocentrism. They took rigorous criticism of modern state of social sciences, naming series of limitations in Eurocentric epistemological approaches. They have included India, America, South Africa, Australia, and Europe [8].

Massimo Pollifroni, in his works, focuses on epistemological analysis of globalization and on paradoxes of globalization of discourse. He believes that globalization is a project of world integration of economics that has negative consequences. For him, epistemological problem represents what is in the vocabulary of economics known as corporatized and mostly senseless, because we cannot determine the meaning of some circulating economic terms. This is why he is close to making a statement that such imprecise discourse leads to dangerous discrepancy between *theory* and *reality*, but also to real violence and injustice. He criticizes corporatization of terms, that is, the vocabulary of economics, stating that there is resistance

to globalization through the "new ethical feeling." Therefore, he believes that we are already living in the "postglobal era." He is convinced that the economists in the twenty-first century will be obliged to have this "ethical feeling" directed against negative social effects of overall corporatization of society. He is convinced that the economic vocabulary must be changed, as well as methodological instruments and the incumbent accounting techniques [9]. Graeber claims that capitalism, in its final, stultifying study, shifts from *poetic* to *bureaucratic* technologies. With poetic technologies, Graeber means using rational, technical, and bureaucratic means for realizing free and unbelievable fantasies. Today, however, Graeber claims there is something completely opposite going on. It is not about encouraging *vision, creativity, and final free fantasies*. It is about making those fantasies "stay afloat"; we do not even pretend anymore that it is possible to shape or embody them. In the meantime, those few fields, in which *freedom, imaginative creativity* are truly nurtured, such as development of Internet software of open code, are used, finally, to make a *more efficient platform for filling forms*. By this, we mean "bureaucratic technologies": administrative imperative, which are not means but aims of technological development, claims Graeber [10].

It is known that we owe to Foucault the far-reaching observation that the *historical epochs* are not different in the fact that people who belonged to those epochs thought, but they are different in the fact of *what was possible to be thought in a given epoch*. Foucault wrote about changes in "episteme"—they were not simple systems of classification, but rather a deep logic on the foundation on which different *classifications* may be construed. Characteristics of different episteme are discrete rules of separation and connection between things for more on topic, see Ref. [11]. Already three centuries of discipline techniques, training, and management have tried to force knowledge that has to be gained and transferred, as knowledge worthy of that name. In that sense, every society, and even global society of knowledge and information, has its own regime of truth, its own politics of truth, its own strategies of extortion of recognition of what surely is knowledge and truth. *Knowledge, power, and truth* are the words—as Paul Veyne claims—that have impressed Foucault. It is not that there should be some kind of furious triad between those three terms. It is mostly to explain in what relationship these terms were in different systems of knowledge, different discursive regimes, and different regimes of truth. However, the special question is what did the thinker of archeology *do*, what did he want to *do* and achieve, with his impressions about *knowledge, power, discourses, and classifications*? What did he do with words and things? What *meanings* did he make when he played with that famous *classification of animals*? Did he run away from truth or did he want to get close to something we call truth? All in all, for Foucault, *thought is essentially connected with the fight and not with the mind* for more on topic, see Ref. [12]. His credit is in this, in the formation of one specific geo-epistemology of human knowledge. Could the archeology of knowledge be applied onto the dominant knowledge about consumerism, western image of globalization? It seems that globalization is the final phase of thought whose representatives do not want to give up from the progressivistic understanding of development—despite that it has not been clear for a long time in which direction we—as an epistemic community—are actually moving.

It would be good if the book, for example, *Educating the "Right Way. Markets, Standards, God, and Inequality,"*[13] written by Michael Apple, could influence more careful questioning of the

meaning of development. The named book could be insightful, primarily, because it questions not only the progressivistic economic thesis about development but also the ruling general thesis about *neutrality of knowledge* and technology in the age of domination of economic model of development. Apple believes that the starting statement about *neutrality of knowledge* is simply not correct. Question about knowledge, about *whose knowledge is*, whom it belongs to, who chooses it, and how does one justify it, represents a constitutive question for understanding the *paradox of globalization*. When we think about *whose knowledge is*, we should try to think in different directions. It seems that today, and today lasts too long, no one at all may show *were forward is*. Could knowledge go backward, in paradox terms? Where is that forward? It seems that also the ontological dimension is the future colonized by economic discourse about the infinite, limitless development. How can we, in progressivist language of the new knowledge economy, speak of progress or improvement of our systems of knowledge? To make it even more concrete: how can we, with the same progressivist language of economic "science" write our syllabi? Who are we, as a global epistemic community writing our syllabi to when we anticipatively speak of *expected learning outcomes—of objectives—of methodologies*? The leading structure of understanding—"discourse" (discussion)—determines what may and what may not be known. It determines what we may let slide as the "truth" and "real" and what is lost as a "myth," "made up." Is it actually power rather than knowledge—power that is found in the foundation of discourse about globalization and connected to colonialism, racism, sexism, and hegemony? And if it is, in what way is it happening and why is there so little and rarely talked about? for example, see Refs. [14–16] After multi-decade, radical crisis of economic paradigms of knowledge—that were included on the inside in the education building of the global society of knowledge—we need different, alternative perspectives of naming people, things, and events. I am sure that we are standing in front of a long-term task of constructing new programs of work that would be directed toward the epistemological and moral recovery of social sciences, and I think especially of the new information economics of knowledge and skills. The task consists of how we should learn to forget what it is learned wrongly and learn how to learn from the start. For a long time, it was necessary to educate different *imaginary meanings* of time and space. In many places, there is free intellectual space missing, a space for free thinking and understanding of the irreplaceable educational role of social studies and humanities. Considering the positive and negative experiences of different ideologies, it is necessary to reconstruct vocabularies of social sciences and humanities that have become overly technocratic and instrumental. Sociological and philosophical opinion must not become instrumental or dogmatic. It must shape the new critical opinion of the world and the man in that world. It must take over historical responsibility for that tough intellectual task.

Until the end of this chapter, we should—in the context of expressing symbolic resistance toward the dominant economic-political-militaristic scheme of development—try to point to the complex interconnection between knowledge and power. This connection was unmasked also by Teun A. Van Dijk, when he wrote: "That which is considered knowledge in any period or community is determined by the one who has power to define and determine the truth within a society (public opinion, church, media and science). This argument will also correctly predict that if certain minorities, dissidents, or individuals express beliefs that they find (or even justify) to be the truth, they will not be believed, or their knowledge will be disregarded as just an opinion, or they will be prevented to express their own beliefs [17]."

It is known that since the creation of philosophy, critical thinking faces dangers of misunderstanding of complex relations and co-relations between science, philosophy, theology, and so on. It is the same today. Because, we, as human beings, without consolation of universal theology, as theology of all possible theologies (regardless of the fact that something like that does not and could not exist), could not probably know, but we could maybe only believe that we know "who the one is" who could eternally answer the hardest philosophical, sociological, metaphysic, theological question, which is: *who does the future belong to?*

Ecological pollution of the earth, air, and water represents the greatest possible global threat of survival on earth. Only danger from nuclear catastrophe could measure up to this problem. Commercial media rarely present the ecological threat in public, as a global ecological threat that endangers life on earth. It is rarely spoken of that we may already be late for correct understanding of the meaning of growth in order for our relationship toward nature and ourselves to change—and to timely prevent this catastrophe from happening. Moreover, there still are a large number of those who believe that ecological problems are false problems, that is, made up. However, sociologists and other responsible scientists are aware that the danger of ecological catastrophe is extremely large: "Environmental problems have become such a emphasized line of social life in the twenty-first century that sociologists would have to try very hard to find any empirical topic that would not, in this way or that way, be under their influence [18]. If sociological researches do not include consideration of ways in which social and natural systems overlap, their explicative value will be lowered," claim Randolph Haluzy-Delay and Debra J. Davidson. This means that finding efficient answers to ecological threats will depend on, before all, the competency and courage of our educational institutions (institutes and universities before all) to execute a decisive *epistemological reconstruction* of all our "systems of knowledge." We should, before all, find ways to stop commercial-corporative, hegemonic trends, and practices in order for all social sciences to be submitted to economic model of a man (*homo oeconomicus*). In order for this to be possible, it would probably be necessary to educate the wider consensus that our human activity is rooted at the same time not only in the economic but also in social, political, economic, and geo-epistemic constructions that all together have the same earthly foundation. Global epistemological situation in sciences never depends only on science and scientists. Epistemological situation also depends on institutional environment. That is, on complete social conditions and ways in which people, who are not scientists, perceive what scientists do. However, the problem is in that administrative-bureaucratic specialization (differentiation) of various areas of science does not let broader integrations (de-differentiation) of various areas. Some bold scientists, through their own creativity and dedication, try to point to epistemic and institutional limitations of the new corporative science that is dangerous to survival of the research community itself. However, is there such a thing as a global epistemological situation and global epistemic community? Before we even try to answer to those questions, someone may think that we should search for answers to other questions that are not purely sociological, purely philosophical, or purely epistemological, but they deal with the possible *meaning* of "emerging society," that is, global society of knowledge in the twenty-first century. Pessimists believe that until there are large differences in material and financial resources dealt with by various epistemological communities (where it is already implied that a unique socially epistemological community does not exist), it would be very hard to speak of a common epistemological

foundation of sociology of knowledge about globalization. Regardless of that, I believe that the new sociology of knowledge, which is emerging right at the moment, owns cognitive capacities for far-reaching criticism of what we called knowledge about development and progress. Epistemological crisis of knowledge creates circumstances in which it becomes clear that we should definitely ask ourselves over again: in what way, and in which conceptual categories, we should analyze our life in order to, on the foundation of those analyses, be able to improve it.

After 40 years or so of very fruitless discussions about postmodernism, and after almost 30 years of discussing globalization, there is a feeling of satiety from epistemological and moral relativism contained in those discussions. Postmodernism will remain remembered by its distrust toward definitions and toward meta-narrations, while globalization will remain remembered as the greatest possible meta-narration. A meta-narration that, because of its *fake plurality*, we almost did not even recognize as a falsely "successful" meta- narration. We say falsely successful because that narration, it seems, with the help of symbolic capital of the new knowledge economy, has "successfully" replaced almost all other narrations about development.

It is necessary to re-actualize the question of *limitations of economic growth*. Without the initial change of perspective, without new concepts, that is, without *new meanings* that we assign to old terms (e.g., progress, growth, and "*development*"), we probably cannot understand that in the foundation of all crises (which we painfully face at the end of the second decade of the twenty-first century) there is a social-epistemological *crisis of meaning*, that is, *crisis of utilization of terms* which we got used to (by mistake). However, this is not the end of the story. It should be the new beginning. There are already certain epistemologically un(certain) attempts made, to outline *foundational conceptual tools* to advocate for a different society. Different from this in which we live in, therefore, it is necessary to emphasize possible meanings of the term *degrowth*. This term is, at the same time, used in at least threefold meaning: (1) as a synonym for renewal of utopian energies, (2) as the fastest *growing* global social movement, and (3) as a term for *conceptual frame* with which we differently show the transformation and utilization of energy and materials on planet Earth; social structures that use a part of that energy; those management mechanisms that direct that use [19]. They say, when we can express what we want with everyday language, we need a new conceptual frame, that is, different *conceptual scheme*. With the term *degrowth*, we wish to strongly mark distancing away from the imperative of growth. All institutions were created by collective action of people, so their good and bad sides are something we must take responsibility for. This is how courageous researchers believe, researchers that work together on creation of vocabulary for the new era. There are a series of terms in the vocabulary. Their meanings should be explained. Unfortunately, we do not have enough time to explain all these terms in one chapter, such as this one, the one we think of as an experiment. This is why we will name only several of those terms and their central meanings. The term "décroissance" (a French term for *degrowth*) was first used by a French sociologist Andre Gorz 1972. He asked many questions about the balance of Earth, material manufacturing, and capitalism that are found even today in the core of discussions about what is *degrowth*, and what could it mean. The following term in the vocabulary for the new era is *anti-utilitarianism.* It is a worldview that criticizes predominance of epistemological starting points of economics in humanities and social sciences. Anti-utilitarianists criticize

utilitarianism because it impairs a human being. *Social metabolism*—this term describes a pattern of material and energetic flows that may be connected with expression of functions and reproduction of structures of human society. Similar to metabolism of living beings, which need a certain sequence of complex chemical reactions in their bodies in order for them to function, the term social metabolism describes a named sequence for replenishment of the society itself. *Environmental justice* relates to the right that an individual may stay in a place and environment that he/she belongs to, protected from uncontrolled investment and growth, contamination, land usurpation, speculative investments, de-investments, collapse, and neglect. To this, we should add *movements for environmental protection and political ecology*— an approach that combines ecology and political economics, in order to deal with questions of relationships between *society and natural resources*, and between social *groups and classes* that have a different, unequal approach to these resources (and who use them differently). *Autonomy*—a brave Greek sociologist Cornelius Castoriadis defines *autonomy* as an ability to enforce laws and rules upon ourselves, either consciously or unconsciously. *Decolonization of the imaginarium*—a key term for criticism of imperialism. If *growth* and *development* are beliefs, and therefore "imaginary meanings" (Castoriadis), such as "progress" and all other foundational categories of economics, to get out of them, to leave them, to overcome them, to cancel them (famous Hegelian *Aufhebung*), which means that imaginarium should be changed. Therefore, realization of a just society means *decolonization of our imaginarium*. *De-materialization* relates to a decrease (actually enormous decrease) of the amount of raw materials used in order to satisfy the needs of manufacturing and consumption of our planet. De-materialization emphasizes that (a large part) of our *social metabolism* must be decreased. *Social limitations of growth and social limitations—a thesis on social limitations* is foundational for understanding of the meaning of the term "*degrowth.*" It is not only an issue that growth will not last forever and that it is becoming uneconomical because of its social and ecological expenses. It is about that growth is "un-smart," a goal without reason, a search for the elusive dream [20]. Due to the limitations of space, we will name just other few most significant conceptual terms. Terms with which we emphasize the *paradox* of economic globalization (and *paradoxes* of the "new knowledge economics"), hoping that, perhaps even before the *global catastrophe*, they may be used as the vocabulary for the new era. Here are these terms (in footnotes, we name authors whose definitions we used, or unknowingly modified, for the purpose of this chapter[6]): New economics, Simplicity, Jevons paradox (rebound effect), Energy, Entropy, Hubbert's peak theory, Capitalism, Co-modification, Conviviality, Pedagogy of catastrophe, Growth, Care, Happiness, Common goods, Digital common goods, World sharing, Direct democracy, Ecological communities, Indignados (Occupy), Employment guarantee, Public money, Local

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[6]List of authors whose definitions we used to create a preliminary draft of the vocabulary for the new era: Onofrio Romano, Mauro Bonaiuti, Joshua Farley, Arturo Ascobair, Alevgul H. Sorman, Isabelle Anguelovski, Susan Paulson, Joan Martinez-Alier, Marco Deriu, Dan O'Neill, Serge Lotouche, Sylvia Lorek, Onofrio Romano, Erik Swyngedouw, Giorgos Kallis, Sergio Ulgiati, Christian Kerschner, Samuel Alexander, Blake Alcott, Diego Andreucci, Terrence McDounough, Erik Gomez-Baggethun, Marco Deriu, Joan Martinez-Alier, Marta Condre, Mariana Walter, Serge Latouche, Peter A. Latouche Peter A. Victor Filka Sekulova, Silke Heifrich, David Bollier, Mayo Fuster Morell Juliet B. Schor, Christos Zografos, Claudio Cattaneo, Viviana Asara, Barbara Muraca, B. J. Unti, Mary Mellor, Kristofer Ditmer, Rita Cavario, Iago Otero, Xavier Renou, Tim Jackson, Samuel Alexsander, Giacomo D. Alisa, Giorgos Kallis, Sergi Cutillas, David LIistar, Gemma Tarafa, Chris Carlsson, Denis Bayon, Isabelle Nadia Johaniosova, Ruben Surinach Padilla, Eduardo Gudinas, Philippa Pary, Eduardo Gudynas, Chiara Corazza, Solomon Victus, Antonella Piccho, Mogobe b Romose Giacomo D Alisa, Giorgos Kallis, Federico Demaria.

currencies, Disobedience, Basic and maximum income, Postnormal science, Revision of debt, Cooperatives, Buen vivir, Economics of Stability, Feminist economics, Ubunty, From saving measures to dépensea. It is paradoxical that, considering final ambivalent effects of techno-scientific and information development, main current in social sciences in the twenty-first century are not, say, connectionist organized critical studies of science and technology. These studies could advocate trans-disciplinary, trans-continental, anti-imperialistic, and decolonizing character of new social sciences. They could be in an infinite balanced phronetic communication with cosmopolitan-defined public sphere. These studies should be the main focus of reconfiguration and reconstruction of globalization. They could, say, in a socially responsible way, explain current events in sciences, especially epistemological events related to debates about nature of "rationality," "objectivity," and value neutrality of knowledge and technology, in different contexts dealing with life and violent, biotechnologically (and *tele-techno-teo-teleo-* logically) manufactured death of people, and communities.

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Theoretical-Epistemological Perspectives of Knowledge in the Global Era: A Conceptual Proposal

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Additional information is available at the end of the chapter

Abstract

It deals with the perspectives of knowledge in the global era. It indicates as a starting point in the following question: how is it possible to represent knowledge in a theoretical-conceptual character in the global era considering the construction of knowledge in networked society, as well as the relations between knowledge of knowledge and other terminologies? It aims to investigate the main fundamentals and characteristics of knowledge in the global era, representing the multiple conceptual relations in the social, valuing, procedural, technical, and psychic context, aiming at the reflection and construction of an integrated concept on knowledge. It concludes that each typology of knowledge presents a concept, and the junction of concepts institutes a general concept about knowledge.

Keywords: knowledge, epistemology, global era, concept, network society, types of knowledge, social, evaluative, procedural, technical, psychic

1. Introduction

Knowledge is a highly studied and controversial subject in the history of mankind and science. Due to the association with several areas/fields/sectors of human and scientific knowledge, knowledge is the central point in understanding the reality of the universe in a general way.

Knowledge in the global age has been a key in explaining the course of humanity and the constitution of social means, relationships and interactions, in particular, by the new technological and linguistic perspectives available for the production and promotion of

access/circulation/use of knowledge on a world level, which deal with a plural process of cognitive and cultural miscegenation.

The so-called "information and knowledge age" brings up, on the one hand, a certain skepticism in the sense that these new forms of production and socialization of knowledge can promote new forms of social inequalities, but also brings about the emergence of a new social order that establishes a new social/global scenario based on the autonomy of subjects in what concerns the sharing of knowledge.

This chapter presents a theoretical-conceptual approach to knowledge in the global era. It indicates as a starting point in the following question: how is it possible to represent knowledge in a theoretical-conceptual character in the global era considering the construction of knowledge in networked society, as well as the relations between knowledge of knowledge and other terminologies?

It aims to investigate the main fundamentals and characteristics of knowledge in the global era, representing the multiple conceptual relations in the social, valuing, procedural, technical, and psychic context, aiming at the reflection and construction of an integrated concept on knowledge.

The chapter consists of three topics:

(a) The first deals with the perspectives of knowledge in the global era reflecting on some of the characteristics of the so-called information and knowledge age in the network society;

(b) The second deals with the conceptual relations between knowledge and other terminologies through the division into knowledge typologies of social, valuing, technical procedural, and psychic nature;

(c) The third proposes a concept for knowledge within the global era.

This chapter seeks, in general, to base the foundations to resize the understanding about knowledge and, mainly, to formulate a key concept to promote new reflections and studies.

2. Perspectives of knowledge in the global era

There is a certain consensus in science history and in the history of mankind in general that knowledge is one of the elements that most exerted and exerts impact/influence in societies, since knowledge would be the justified rationality, able to explain the various senses of reality, seeking forms of creation/innovation for human development. Therefore, knowledge constitutes as the first fundamental characteristic relation between the human being/person/individual/subject and the social reality, presenting relational variations, according to the historical context. We opt for the use of the term "subject" since it considers a concept, which occupies space/environment in frank cognitive development mediated by the languages and technologies before the perspectives of appropriation of social reality.

The period between the end of the twentieth century and the beginning of the twenty-first century brings new forms of relations between the subjects and the social reality, configuring the construction of the so-called information age, based on the foundations of a networked society.

Knowledge, as a deep concept of social reality, reaches in contemporary times, global perspectives of production, and appropriation revealing a semantic-pragmatic interdependence, since knowledge is as much a concept that promotes meaning and dynamics to the subject as it is associated with other concepts such as data, document, message, communication information, belief, ideology, culture, truth, intelligence, language, technology, among others (this discussion will be better explored in the next section).

It happens that knowledge in the global era is placed as the center of attention eminently associated with the concepts of dominion (detention and appropriation) and power. The domain presents itself under different variables. It can be established, on the one hand, as the appropriation of the social reality for grouping of contents and formation of strategies for action or, on the other hand, as imposition and supremacy establishing precepts (rules and regulations of a particular local, regional, national, continental, or planetary social group). While power has two broad general axioms: the first refers to the idea of possibility of doing something and the second to deliberate or command, through force, according to the contexts of beliefs that present themselves to the human beings involved in the relations of knowledge.

Knowledge in the global age conquers plural dynamics by virtue of the multiple possibilities of domains and powers between the subjects. It is the power that shapes the forms of construction, application, and mastery of knowledge in global reality by fostering a decentering of knowledge in the global era. According to Castells, [1],

> *Power is no longer concentrated in institutions (the State), in organizations (capitalist companies) or in symbolic mechanisms of control (media companies, churches). On the contrary, it diffuses in global networks of wealth, power, information and images, which circulate and are transmuted into a system of variable geometry and dematerialized geography. However, power does not disappear. Power still governs society; still shapes and dominates us […] The new form of power lies in the codes of information and in images of representation in which societies organize their institutions and people build their lives and decide their behavior. This power is found in the minds of people.*

Knowledge is denoted as one of the main forms of power in globalized contemporary times, since it has been the driving force, which governs the state, society, companies, churches, family, social movements, political parties, regulatory bodies, besides education, culture, health, environment, technical-scientific practices, and so on. However, this knowledge-based power government depends, above all, on beliefs, ideologies, cultures, and technological devices that subjects (in this case, institutional subjects such as state, private, or alternative organizations as the third sector and/or human subjects as persons that have knowledge reference in certain social groups) hold to establish social domains.

Thus, power, via knowledge is "[…] defined as the ability to structure the field of action of the other, to intervene in the domain of their possible actions and not directly on their will" (AGUIAR) [2]. Knowledge is rationally justified, but it can be dynamically transformed, according to the contexts and desires of subjects, overcoming the notion of peremptoriness or the impervious character of knowledge.

In addition, for power, via knowledge, to consolidate in the global era, there is a central assistance: the perspective of virtual mediation between institutional or human subjects at local, regional, national, continental, and/or global level, which determines the multi-relational character of knowledge. This virtual or cybernetic mediation is the driving force that characterizes the global character of knowledge between institutional and human subjects, considering that the goal is no longer to potentiate power by physical or energetic force but by the strategy of the human mind.

In the global era, the desideratum of relations between subjects and social reality, conceives knowledge as a storage construct in the human mind. For this, this storage is fundamentally constituted from the use and interaction by the cybernetic devices. The device as understood here echoes with great sensitivity of Foucault's speech [3] who defines it as,

> *A decidedly heterogeneous set which encompasses discourses, institutions, architectural organizations, regulatory decisions, laws, administrative measures, scientific statements, philosophical, moral, philantropic propositions. In short, the said and the not said are the elements of the device. The device is the network that can be woven between these elements.*

The device is the plural construct defined by institutions/organizations, discourses, norms/laws, scientific, philosophic, administrative, juridical, and mediatical practices and propositions that is routed through the relations between the subjects and the social reality, via cybernetic mediation, which provides the elemental fruits for the formation of a network society or a informationally globalized society.

Thus, knowledge in network society or global era is characterized by a set of pluralisms, which can be divided, namely:

(a) Relational pluralism—it involves various forms of relations between institutional or human subjects with social reality from the multiplicity of existing devices;

(b) Temporal pluralism—virtual mediations, although real, are not necessarily current, implying a diachronic tension between mediation and instantaneity in knowledge construction. The more rapid and consistent the virtual mediation between the subjects, the more possibilities are there for the construction of a temporally solid knowledge, which will establish forms of domination and power in certain social groups;

(c) Spatial pluralism—it deliberates on two general connotations: the first is about the set of cybernetic devices to dynamize the interactions between the subjects and the social reality, and the second on the intercultural relations between subjects, promoting multiculturality and cultural heterogeneity meaning that spatial pluralism redefines the formation of searches, the forms of interaction and cultural construction of the subjects;

(d) Pluralism of beliefs—it is a consequence of the first three pluralisms, since pluralistic relational, temporal, and spatial perspectives are fundamental to (re) dimensioning of beliefs of institutional and human subjects. For example, a company (institutional subject) that previously invested in a particular country, state, or municipality and obtained recognition but through the relational/temporal/spatial pluralities, begins to observe difficulties, weaknesses, and losses, it can modify its beliefs seeking new forms of investments or a

person who had a previous perception, a priori, about the culture of a certain region or nation, and through relations with subjects from this nation or connoisseurs of this nation's culture, can (re)dimension his or her beliefs about the perception he or she used to have about this culture.

To sum up, knowledge in the global age possesses a deep mark of a network society based on the decentralization of power and on a set of pluralisms that make knowledge, a determining concept for understanding the world that is constantly changing. This concept of knowledge depends on the relation with other concepts, especially, information and message to be sufficiently assimilated and diffused.

3. Fundamentals of knowledge in the global era: terminological-conceptual correlations

As mentioned in the previous section, knowledge is a concept that presents an effective theoretical-semantic interdependence with other concepts, such as data, document, message, communication information, belief, ideology, culture, truth, intelligence, language, technology, and so on. This interdependence promotes ontological, logical, historical, and pragmatic liveliness to knowledge.

The relationship between the concept of knowledge and other terms is synthesized from five typologies concerning **social**, **valuing**, **procedural**, **technical**, **and psychic** aspects, as shown in the table below (**Table 1**).

Knowledge has multiple conceptual variables and to constitute itself as such, it needs to be thought from the five typologies exposed. A priori, knowledge, in its conceptual completeness, involves the five typologies, but each typology advocates a concept, considering that there is a conceptual interdependence between the typologies. In theory, these conceptual relations do not have a linear ordering, since the social, valuing, procedural, technical, and psychic character may converge in a specific or general character and particular or simultaneous character for the construction of knowledge.

Social	Valuing	Procedural	Technical	Psychic
Environment: natural and social environments	Belief	Data	Language (natural and artifitial)	Mind
Objective reality Social daily	Ethics Moral	Message	Technologies	Thought Idea
Social relations	Ideology	Information	Document	Intelligence
Interaction Social interaction	Memory	Communication	Services and products	Conscience

Source: elaborated by the authors.

Table 1. Typologies of conceptual relations between knowledge and other terminologies.

The relational typologies of knowledge deserve a set of considerations contemplating the peculiarities and generalities.

To Zagzebski [4], firstly, knowledge is divided into two elementary fundamentals: first, it is usually called knowledge by contact, since the subject is in contact, through experience, with the portion of known reality; while the second type is called the propositional knowledge since that what the subject knows is a true proposition about the world. The five typologies are synchronized with the configuration of knowledge by contact and/or propositional knowledge, and each typology has peculiarities in the form of undertaking meanings and actions in the aspirations of contact and propositions. For example, the social typology is eminently constituted by contact but can only be fully understood by the propositional aspect. The procedural typology in turn is broadly propositional but needs the contact to elucidate the foundational aspects of the knowledge to be treated. Therefore, in this text, the emphasis is more focused on the propositional knowledge, since it is able to explain and give meaning to any phenomenon related to the construction of knowledge.

Second, the typologies carry a (pluri) contextual vision about the procedures for the construction of knowledge. The (pluri) contextualism implies in the various/plural possibilities/perceptions about how knowledge can be constructed and appropriated by the subjects. As Stine [5] states "it is an essential feature of our concept of knowledge that firmer criteria are appropriate in different contexts. Knowledge is one thing in a casual conversation, another in the classroom, another in the court, and who would say it could not be another in a philosophical discussion";

Third, **social typology** is the principle of conceptual understanding of knowledge. In the first place, all construction of knowledge takes into account natural and social aspects of the environment, so that they are the basic elements for the existence of the subjects and initial determinants for the construction and understanding of knowledge. The objective reality/social daily life is the dynamics of the experiences/practices of human processes of the environment in which subjects deal and produce knowledge. Social relations establish the basis of the social structure of the subjects enabling a process of self-organization of coexistence, affective, spiritual and cultural practices, and general construction of values. Interaction is the *sine qua non* condition for the transformation of the environment and social reality promoting perspectives for the construction of knowledge, as it is present in diverse human, natural, scientific, institutional, and spiritual activities. Interaction is the mediating act which mobilizes all the other typologies. Therefore, interaction is one of the mediating driving forces for the construction of knowledge by approaching subjects and modifying realities;

The interaction denotes the construction of a praxiological knowledge, which takes a broader and more concrete dimension of the environment and social reality. Praxiological knowledge has as its object not only the system of objective relations that the form of objectivist knowledge constructs, but also the dialectical relations between these structures and the structured dispositions in which they are updated and tend to reproduce, Bourdieu [6] points:

> *[…] this knowledge supposes a rupture with the objectivist mode of knowledge, that is to say a questioning of possibility matters and, hence, of the limits of intentional and objective point of view that apprehends*

> *outside practices, as a finished fact, instead of constructing its generative principle, situating itself on its own movement of effectiveness.*

The interaction, thought as a generator of praxiological knowledge, surpasses the idea of a superficial objectivism of absorbtion of reality and in a phenomenological way of valuing only the first experience of daily life. Interaction as a promoter of praxiological knowledge focuses on the social processes, from their origins, going through the procedures/strategies, arriving at the purposes, and culminating on new forms of (re)construction of the social reality.

Fourth, **valuing typology** entails the formation of the appropriate abstractive factors of social reality. The values of belief, ethics/moral, and ideology have a common characteristic in the construction of knowledge: the need to value the historical process of a causal, procedural, and consequential nature in an integrated and articulated way. Nietzsche [7] summarizes the historical concept of affirmed value that the characteristic of the largest period of the history of mankind, called prehistory, was to value an action according to its consequences. The act mattered as little as its origins. In the middle of the nineteenth century, the situation changed and the value ceased to be attributed to the consequences of the action to focus on its causes. This represents an important event, the product of a great refinement of judgment, the distant and unconscious effect of aristocratic values, of the belief in the "origins," the distinctive sign of a period we might call the moral period of humanity, definitely the first step toward the knowledge of oneself. So the action happens in a reverse way and replaces the search for the consequences. It is a matter of finding the origin, this inversion being the fruit of long struggles and prolonged attributions and a singular narrowness of interpretation, which came to dominate. The origin of an act in the strictness sense of the term is linked to an intention in which this is by itself the origin and the prehistory of the action.

Thus, based on the values of belief, ethics/moral, ideology, and memory, knowledge must consider the historical foundations and the relations between origins, development, and purposes as a kind of more logical and coordinated construction of social phenomena inherent to the production of knowledge.

Fifth, **procedural typology** encourages the dynamization of the social and valuing typologies through communicational/informational practice. The conceptual relation between information and communication, understood here as Dacheux highlights [8] "information is what makes communication flow; communication is the flow of information" is what gives the regulating and organizing sense of the publicity of knowledge as a praxiological phenomenon.

In sixth and in addition to fifth, **technical typology** brings to the fore, the formal record of **procedural typology**. Therefore, procedural and technical typologies are intrinsically concatenated, being the first one–a strategic typology for the publicity of knowledge and the technical–a typology of registration of knowledge.

Otherwise, the technical typology allows the materialization of procedural typology, which, in turn, fosters a cognitive-praxiological sense of the social and valuing typologies. Frohmann [9] explains that the public and social character of information/communication (basis of procedural typology) has its consolidated expression when a critical analysis of the various expressions

of the document is conceived (basis of technical typology together with the language and technologies) in face of the needs of the user or, otherwise, the information studies that claim the concept of materiality from the notion of document bring a broader understanding of the public and social character of information.

Technologies, especially virtual/digital, are the basis of the knowledge foundation in the global age by redimensioning in a temporal space perspective, more specifically, the multiple meanings of language, of document and technical typology and, more generally, the social, valuing, procedural, and psychic typologies.

Lastres and Albagli [10] affirm that technologies favor the global age of knowledge, expanding boundaries in social relations, and interaction between subjects, as well as modifying the technical-scientific practices for the production of new knowledge. The theses which consider that globalization implies homogeneous spaces and a world "without boundaries" are those that suppose that information, knowledge, and technologies are simple commodities that can be "transferred" under the mediation of the markets via mechanisms of price. In these analyzes, the advances in information and communication technologies are credited with the possibility of joint realization and coordination of research and development activities by participants located in different countries of the world, allowing both the integration of them on a global scale, as well as the rapid and efficient diffusion of generated technologies and knowledge.

Finally, the **psychic typology** is a condenser of all other typologies, so that absorbs and abstractally appropriates all the praxiological development of knowledge contained in the previous typologies. The mind is the broader abstract refuge that contemplates thought/idea, the formation of intelligence and conscience.

In particular, with regard to conscience, it is pertinent to reflect that the social, valuing, procedural, and technical typologies consubstantiate the psychic typology of knowledge, that is, the psychic typology is possible only according to the existence and development of all other typologies. Marx's [11] speech is salutar when he states that "[…] it is not the consciousness of men that determines their being, but, on the contrary, their social being that determines their consciousness"; "[…] the senses immediately became theoretical in their practice […]".

The Marxian discourse justifies the reason why the social typology was inserted as a principle and the psychic typology as an end. However, the psychic typology does not come to a peremptory end but brings new conceptions on social typology by deliberating new perspectives to understand the construction of knowledge from the social typology.

The following typologies will allow, in the next section, the proposition of knowledge concepts mentioned in the present study.

4. A conceptual proposal for knowledge in the global era

In view of the discussion in the two previous sections, it is pertinent to propose concepts for knowledge in the global era by considering the characteristics of knowledge in global society

and network society, as well as the established typologies of knowledge. It is worth emphasizing that each typology generates a specific concept for knowledge considering the conceptual amplitude of the term in the global age.

Before proposing, the concept of knowledge is pertinent to recognize that knowledge is essentially linked to a phenomenon, that is, an occurrence embedded in social reality. Knowledge as a phenomenon is intrinsically linked to the concept of information. According to Silva [12], information is seen as a multiply-produced phenomenon for the production of knowledge.

As knowledge has a (pluri) contextualist character, as indicated in the previous section of this study, it is possible to understand it in initial definition as a set of phenomena. Therefore, the typologies conceived enunciate the embryonic idea of knowledge as a set of social, valuing, procedural, technical, and psychic phenomena.

Knowledge is understood as a set of phenomena in the sense of instituting itself in a set of occurrences and events from the social reality through interactions, determining in the scope of beliefs, ideologies, languages, and technologies, a socially generated conciousness, since according to Oliveira [13], the transgression of knowledge as an objective phenomenon can only be effected through practice.

The first concept of knowledge within the scope of social typology can be defined as the following table indicates (**Table 2**):

The concept of knowledge in social typology is associated with two factors: objectivist knowledge of reality (considered more reductionist because it values not the social process as a whole, but only the contact and the experience with the environment) and the praxiological knowledge proposed by Bourdieu [6], because it is a concept that recognizes the breadth of social processes (from the means to the interactions, expositions, and discoveries promoted in the interactionist practices) to understand knowledge and not just the objective phenomena.

The praxiological knowledge indicates the comprehension of social actions and their due resolutions of problems, considering that the subjects involved in the construction of knowledge must observe the different objective realities, seeking the perception of the interiorization of the social and (external) natural environment and the exteriorization of the internal (the dialetical-praxiological movement between what exists in reality, what is perceived and internalized) and, finally what is externalized (transmitted).

The second concept referring to the valuing typology is indicated in the table below (**Table 3**):

Typology	Concept
Social	A set of phenomena extracted from the natural and/or social environment, outlined in the objective reality/daily social within the scope of social relations through interactions.

Source: elaborated by the authors.

Table 2. Concept of knowledge within the scope of social typology.

Typology	Concept
Valuing	A set of phenomena justified by a belief, promoted by an ethical-moral conduct, based on an ideology grounded on temporal processes linked to memory.

Source: elaborated by the authors.

Table 3. Concept of knowledge within the scope of valuing typology.

The concept of knowledge in the valuing typology has a more philosophical character. Because, it is linked to the structuring of social thought, the concept of valuing typology brings a more reflective meaning to the concept of social typology, allowing a critical-applicable dialog to the concepts of the following typologies. It is from a social and valuing perception of knowledge that it is possible to think in a more praxiological way the procedural, technical, and psychic typologies.

To Rokeach [14], the idea of an valuing typology for formulating the concept of knowledge lies in the fact that belief transcends the attitude toward objects or toward situations; it is a pattern that guides and determines action, attitudes toward objects or situations, ideology, presentation of oneself to others, evaluations, judgments, justifications, comparisons of oneself with others, and attempts to influence others. The belief is sustained by the values produced throughout the historical process, receiving support from ideologies and supported by the preservation of mental and institutional memory.

The third concept, referring to the procedural typology, has the following formatting (**Table 4**):

In this conceptual proposal, knowledge is strictly associated with the concepts of information and communication. Regarding the relationship between knowledge, information, and communication, there are two aspects that act as consequences of the social and valuing typologies.

The first strand lies in Barreto's discourse [15] when he states that the relationship between information and knowledge is only realized "[…] if the information is perceived and accepted as such, placing the individual in a stage of development, self-conscious and within the world where their individual odissey is carried out". This means that the relation of knowledge with information is supported by belief, based on the contact with social reality, that information is accepted by the subject as capable of semantic meaning by inserting it into a cognitive development modifying its perception about social reality.

The second strand is more intimate because it is based on the idea that, according to Wersig [16] "[…] information is knowledge in action […]". However, the concept of the author does not represent a conceptual totality, since knowledge in action is established more broadly through the communicational-informational process, which involves the application of data,

Typology	Concept
Procedural	A set of phenomena conceived from data, sent by message and dynamized strategically through informational and communicational processes.

Source: elaborated by the authors.

Table 4. Concept of knowledge within the scope of procedural typology.

message, production of information, as well as the use of technologies, languages (natural and artificial) and document, and finally, of the mental processes concerning the use of social consciousness so that knowledge is development in communicational-informational perspective, allowing the construction of new knowledge.

This means that information and knowledge do not have the same meaning but are inextricably coordinated so that they have a social-praxiological meaning. Knowledge is seen most strongly as a communicational-informational process, undertaken with the help of technical and psychic typologies, being synthesized as "[…] communicated knowledge regarding some particular fact, subject or event; what is transmitted, intelligence, news […]" (OXFORD ENGLISH DICTIONARY, 1989 apud BUCKLAND). [17]

In a synthetic way, the relational concept between knowledge, information, and communication is represented in Silva's discourse [18] stating that "[…] the social information, resulting from a human subject, active, apt, and ontic disposition to know and communicate—knowledge and communication differ from information, although, they form with it a coherent and essential unity […]".

Information is, in turn, constructed through social reality which includes a range of previously communicated knowledge that are disseminated in the social and natural environment that allow the construction of new knowledge and communicational processes. Therefore, information and communication (including data, messages, technologies, languages, and documents) dynamize the exposed knowledge and contribute to the construction of new knowledge.

The fourth concept is specified in the following table (**Table 5**):

The concept of technical typology of knowledge is directly related to the concept of procedural typology. All procedural knowledge (communicational-informational) depends on a technical knowledge (formulated from technologies, language, document, and services/products) to consolidate, since the technologies have the decisive role of making feasible the multi territoriality and multi referentiality of mediation and dissemination of knowledge, while languages (natural and artificial) act as an organizing subsidy of knowledge through a verbal and nonverbal perspective, while the document is the concrete support, which represents the dynamics of the action of technologies and language and, therefore, formalizes the communicational-informational activity (procedural).

In this way, there is a conceptual extension of procedural knowledge to technical and of technical to process (reciprocity character) from a coordinated articulation so that the knowledge of social and valuing typologies are dynamically applicable.

Typology	Concept
Technical	A set of phenomena based on natural and/or artificial language, structured/registered in a (multi) spatial mode by technologies (physical and digital), represented in documents and pragmatically invigorated by services and products.

Source: elaborated by the authors.

Table 5. Concept of knowledge within the scope of technical typology.

The language issue is fundamentally relevant for the fluency of knowledge of the procedural typology from the following aspects: **language as a medium for the dialog in the realm of social reality**; **language as a means of identifying of subjects**; **language as a means of organizing and representing knowledge**; **language as a means of communication and mediation of knowledge**; **and language as a means of supporting information for the construction of knowledge**.

The matter of the document brings the concrete and formal character of knowledge registry. This means that there is much undocumented/unregistered knowledge in the social environment, inhibiting prospects for building new knowledge. It is via document (textual, cartographic, iconographic, filmographic, sonorous, micrographic, information technologies, among others) that knowledge enables new relationships, interactions, and comprehension of the social context.

Silva [12] exposes that through the values of the document, such as historical-mediational, human, social, public, technical, and content, knowledge gains institutional consolidation and perspectives of new social relationships/interactions contributing to the promotion of knowledge sharing.

The fifth concept is as follows, as shown in the table below (**Table 6**):

Typology	Concept
Psychic	A set of phenomena appropriated by the mind that foster the construction of thought and ideas, enhancement of intelligence and selection by consciousness.

Source: elaborated by the authors.

Table 6. Concept of knowledge within the scope of psychic typology.

The concept in the psychic typology is a great condenser of knowledge, after passing through all other typologies. The mind is the abstract refuge of the representation of the external world (environment and social reality). It is the mental organization that defines the constructs of thought and ideas favoring the enhancement of intelligence, and finally, the characterizing character of the conciousness of the cognitive subject (any subject who is in a knowledge building situation).

The concept in the psychic typology is directly linked to all other typologies, especially the social one. Knowledge in the psychic typology elaborates the mental repertoire on everything that is appropriate in other typologies. The contiguity between knowledge in the psychic and the social typology resides in the reflection-conciousness dyad, since, Sartre [19] "[…] the reflexive conciousness (réflexive) positions as its object the reflected conciousness, I am ashamed or proud of it, I accept or refuse it and so on. […] Thus, there is no primacy of reflection on conciousness: it is not revealed to itself by the previous one".

In consciousness, the state of knowledge is selective. It is in conciousness that the subject selects the means he or she has to appropriate social reality and interact. It is in conciousness that the

subject sustains his or her knowledge in safeguarding or revelation of beliefs, ideologies, and his/her moral conduct. It is in the conciousness that knowledge about the communicational-informational processes is. It is in conciousness that the technical aspects such as provision of technologies, language games, and formal records (documents, services and products) are sufficiently tuned to be used by the cognitive subject. To sum up, Nietzsche [7], "[…] concious-ness is the last and ultimate development of the organic **and knowledge** and, therefore, it is also what is more unfinished and less strong about it".

All typologies have specific and integrated concepts. However, all concepts have direct common goals, as shown in the following figure (**Figure 1**):

The stated aims show that knowledge has multiple conceptual variables from the origin (from where knowledge comes), procedures (which assist in the productive development of knowledge), and purposes (what knowledge is destined for).
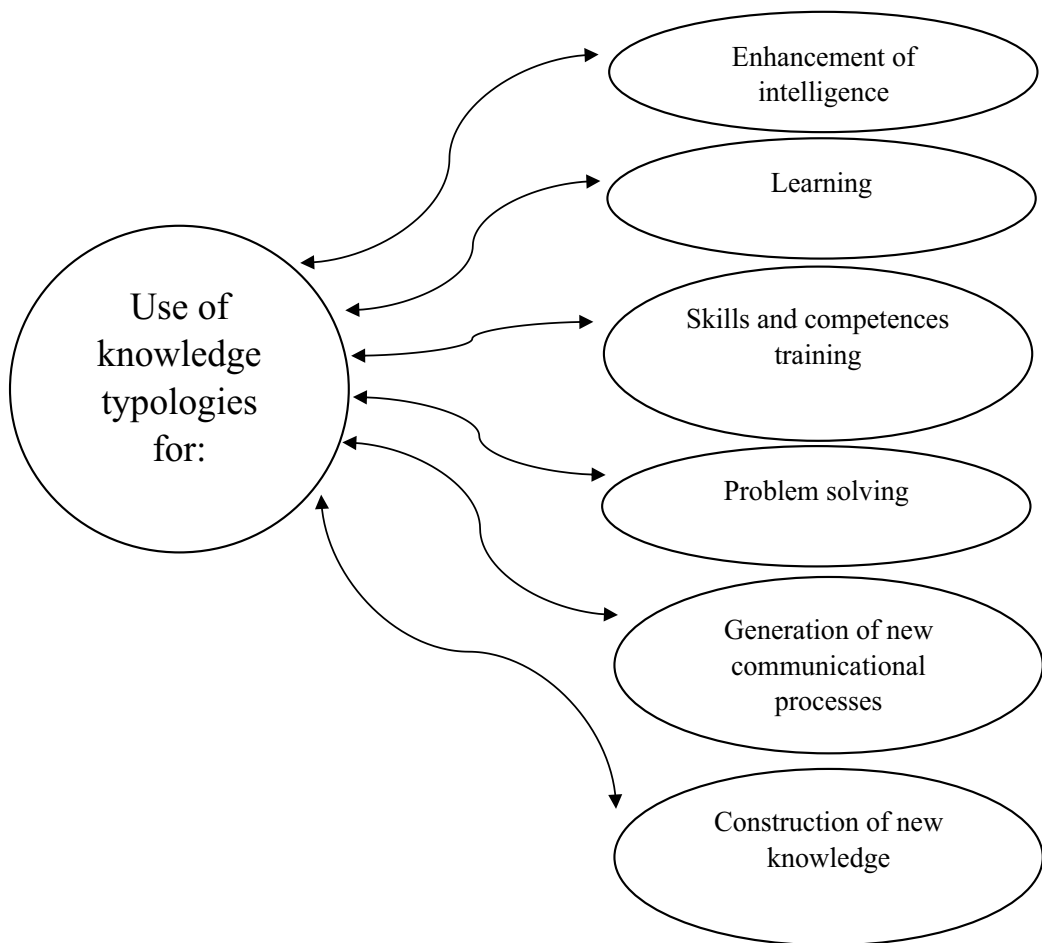

Figure 1. Goals of knowledge typologies. Source: Elaborated by the authors.

In particular, with regard to the purposes of knowledge, it is possible to observe that each point is related to the knowledge typologies delimited in this study. For example, the enhancement of intelligence is directly related to the psychic typology, although it is also fundamental for the redimensioning of social and valuing typologies (in the sense of interaction and values) and to the procedural and technical typologies (in the regulatory and strategic sense). Learning, skills and competences training, problem solving, and construction of new knowledge are related to all typologies, considering that they are vital marks of any activities inherent in knowledge. In turn, the generation of new communicational processes is more inherent to the valuing typology but contributes to the other typologies.

Therefore, the purposes identified in the figure indicate that the understanding of the concept of knowledge is a combination of the diversity of typologies designated in this study constituting an aggregated and holistic concept, as it will be explained in the concluding remarks.

5. Final considerations

Knowledge in the global era has multiple conceptual variations. Therefore, the division into typologies reflects a particularized understanding of knowledge enabling the constitution of a more totalizing concept of knowledge aggregating all typologies.

Thus, knowledge can be conceptualized in the global age as:

A set of phenomena extracted from the natural and/or social environment, outlined in the objective reality/daily social life within the scope of social relations through interactions; justified by a belief, fostered by an ethical-moral conduct, based on an ideology grounded by temporal processes linked to memory; conceived from data, sent by means of message and strategically dynamized by means of informational and communicational processes; based on natural and/or artificial language, structured/registered in a (multi) spatial way by (physical and digital) technologies, represented in documents and pragmatically invigorated by services and products; and appropriated by the mind they foster the construction of thoughts and ideas, enhancement of intelligence and the selection by consciousness with the purpose of improving intelligence, developing learning, stimulating the training of skills and competences, assisting in problem solving, valuing the generation of new communicational processes, and dimensioning the construction of new knowledge. The concept of knowledge is plural insofar as, on the one hand, it is aggregated to the social, valuing, procedural, technical, and psychic contexts and, on the other hand, it is aggregated to the objectivist epistemological, praxiological, and (pluri) contextualist contexts. This means that the concept of knowledge has a semantic-applicable characteristic (based on typologies), a logical-epistemological characteristic (based on theoretical-applicable trends/strands of knowledge), and finally, a teleological characteristic (this defines the knowledge path to change the social reality of subjects, construction of new knowledge, and generation of new communicational processes).

Therefore, the present study sought to conceive a particularized and holistic conceptual perception of knowledge prioritizing the indication of theoretical-epistemological and applicable bases in order to stimulate new discussions, interpretations, and perceptions about the plural reality of knowledge in the global era.

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The Post-Modern Transcendental of Language in Science and Philosophy

Gianfranco Basti

Additional information is available at the end of the chapter

Abstract

In this chapter I discuss the deep mutations occurring today in our society and in our culture, the natural and mathematical sciences included, from the standpoint of the "transcendental of language", and of the primacy of language over knowledge. That is, from the standpoint of the "completion of the linguistic turn" in the foundations of logic and mathematics using Peirce's algebra of relations. This evolved during the last century till the development of the Category Theory as universal language for mathematics, in many senses wider than set theory. Therefore, starting from the fundamental M. Stone's representation theorem for Boolean algebras, computer scientists developed a coalgebraic first-order semantics defined on Stone's spaces, for Boolean algebras, till arriving to the definition of a non-Turing paradigm of coalgebraic universality in computation. Independently, theoretical physicists developed a coalgebraic modelling of dissipative quantum systems in quantum field theory, interpreted as a thermo-field dynamics. The deep connection between these two coalgebraic constructions is the fact that the topologies of Stone spaces in computer science are the same of the C*-algebras of quantum physics. This allows the development of a new class of quantum computers based on coalgebras. This suggests also an intriguing explanation of why one of the most successful experimental applications of this coalgebraic modelling of dissipative quantum systems is just in cognitive neuroscience.

Keywords: semiotics, Boolean algebras, algebra of logic, category theory, coalgebras, quantum field theory

1. Introduction: the semiotic interpretation of the transcendental of language

In this chapter, I suggest interpreting our present age, characterized by deep changes in every realm of the society and of the culture—science and philosophy included—as a Post-

Modern Age, not in the usual nihilist interpretation of Post-Modernity, but in a constructive way. This can be more easily understood if we see at the three ages, *Ancient*, including both the Greek and the Latin ages, *Modern* and *Post-Modern*, from the 'transcendental' standpoint. That is, from the standpoint of the *ontological foundation of truth*, so to characterize the Ancient Age with the 'Transcendental of Being', the Modern Age with the 'Transcendental of Knowing' and the Post-Modern Age with the 'Transcendental of Language'. In fact, during the Ancient Age—Middle Age included—the foundation of truth of the predicative sentences is the *being* of things existing independently of human thought and language, either in the *ideal realm* of the Platonic 'supercelestial world' ('hyperuranium') or in the *natural realm* of the Aristotelian physics. On the contrary, during the Modern age, because of the crisis of the Aristotelian cosmology, consequent to the birth of the Galilean science, the foundation of truth depends on Descartes' and Newton's principle of *evidence*,[1] and then it depends on human knowledge.

On the contrary, Otto Apel introduced the expression 'Transcendental of Language' in the contemporary philosophical debate [1, 2], for signifying the primacy of language over knowledge in our Post-Modern Age. Apel introduced this terminology originally together with Jürgen Habermas, who afterwards refused this connotation of his philosophy and social ontology, as well as the connotation of our age as 'post-modern' [3], because of the prevailing 'anti-modernist' and 'nihilist' meaning that this term acquired in the contemporary debate [4]. Anyway, apart from these terminology questions, what these authors and the others like me (e.g., the American philosopher John Deely, in his monumental textbook 'Four Ages of Understanding' [5]) want to signify as characterizing our age is the completion of the 'linguistic turn', only initiated by Gottlob Frege and Ludwig Wittengstein at the beginning of XX cent. This completion goes into the 'semiotic' direction depicted by Charles S. Peirce at the end of XIX cent., but effectively developed, both in science and philosophy, only during the last 50 years.

The illustration of this later completion in fundamental physics, as well as in logic and in computer science, all related with the 'algebra of relations' and then with the 'Category Theory' (CT), and the consequences for the anthropology and the epistemology, and more generally for the post-modern man that lost in this way his modern centrality, is the main object of this chapter.

Indeed, the scientific contribution of Peirce, often forgotten by philosophers, concerns precisely algebras since he practically 'invented' the algebra of relations [6], so that also his 'theory of

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[1]The "First Rule" of Descartes' *Discourse on Method* (1637), written as Introduction to his treatises on *Geometry, Optics*, and *Metreology* reads: '"never to accept anything as true if I didn't have *evident* knowledge of its truth"' [65]. In the Ancient English of his *Treatise of Optics* (1704), Newton stated: '"These Principles [the laws of Newtonian Mechanics] I consider, not as occult Qualities, supposed to result from the specifick Forms of Things, but as general Laws of Nature, by which the Things themselves are formed; their Truth appearing to us by Phaenomena, though their Causes are not yet discover'd. For these are manifest Qualities, and their Causes only are occult. (…) To derive two or three general Principles of Motion from Phenomena, and afterwards to tell us how the Properties and Actions of all corporeal Things follow from those manifest Principles, would be a very great step in Philosophy, though the Causes of those Principles not yet discover'd' [64, p. 376].

signs' or *semiotics* consists ultimately in the vindication that the fundamental irreducible relations in algebra, and then in logic and mathematics, are not the 'dyadic' ones, like in Boole's and Schröder's 'algebra of logic', but the 'triadic' relations. In this way, also his fundamental theory of 'semiosis', where the signifying character of 'signs', in the wider sense, and not only in the linguistic one, is based on its famous categorical distinction between 'firstness', 'secondness' and 'thirdness' as a triadic structure of relations underlying everything is signifying in language [7], in thought [8] and finally in nature itself [9], depends essentially on the irreducibility of triadic relations.

Therefore, if we approach the issue of the transcendental of language from the standpoint of *a social ontology of language*, without investigating over its 'semiotic' algebraic and pre-linguistic basis, we are almost completely missing the point in two senses.

1. Before all, we are continuing in the Modern prejudice of considering humans as the only actors of the communication interchanges, even though, because language is a social construction, such a 'transcendental subject' has in this approach a collective and not individual nature. This implies that, because the linguistic sign has necessarily a *conventional nature*, as De Saussure taught us [10], this incomplete approach to the post-modern linguistic turn leads us necessarily to an ontological conventionalism, and then back to the nihilist interpretation of our Post-Modern Age. However, De Saussure himself, who emphasized in his linguistics the conventional character of linguistic signs, suggests us an implicit reference to Peirce's semiotics, when he distinguishes in his famous Treatise between 'sign' and 'symbol'. The latter, indeed, is characterized for him as to the former by a 'natural bond' in the brain between 'signifier' and 'signified'. This makes effectively 'triadic' the semantic relationship in its 'physical' foundation, apart from the social construction of meanings by the linguistic interchanges. Even though De Saussure's 'semiology' never considered Peirce and his semiotics, nevertheless, such a triadic nature of symbol, and its intrinsic 'natural bond' in its pre-linguistic constitution, is copying with the 'semiotic naturalism' of Peirce's ontology [9]. This position led the American philosopher to define himself during all his career as a 'Scholastic realist' on a naturalistic basis that makes his position equidistant, both from a Platonic realism and from a linguistic conventionalism [11]. This suggestion introduces us immediately to the second main reason of the failure of the interpretation of our age as per a social ontology of language.

2. Indeed, such an ontology is completely missing the point of the deep changes we are facing in our culture, and in our society—in economy, and hence in politics, before all—as well as in fundamental sciences, namely, in physics, mathematics and logic. All these changes have, indeed, a common denominator in the *information revolution* we are facing today, and that will challenge much more our societies, our economies and finally our political and military systems, *on a worldwide dimension*, in the very next future. This revolution depends, on the one hand, on the amazing increasing of computing power of devices related to the actual and growing availability on the market of quantum computers that, in a quantum optics implementation in nano-technology, will not require like the actual quantum computers in electronic implementation to work at $-273°C$ (thinks for instance at the famous D-Wave). In this way, they will be used practically like our electronic CPU's, but with a power and a velocity

of calculus some orders of magnitude higher, and with a power consumption of few watts. On the other hand, this revolution will depend on the development of the so-called *AI autonomous systems* (think at the self-driving cars, robots, drones, etc.), destined to change deeply every realm of our private and public, civil and military lives, on the other one. Despite these two branches of development seem independent as to each other, they are deeply connected from the theoretical standpoint, as we see. From the standpoint of social ontology, all this means that beside the '*conscious* communication agents'—that is humans, both individually and collectively intended—there exist also the '*unconscious* communication agents', i.e., the computational systems, in their networking with humans, to be considered as main actors of the actual social scene. They are acquiring an ever-growing role in the interchanges of information, of goods and of services within our societies, changing completely the financial and labour markets in economy, but also the access to cultural contents, the formation and the control of public opinions and, finally, the notion of democracy itself. This is making suddenly obsolete the classical and modern philosophical interpretations of our societies based on the centrality of individuals, and the related Gibbs' statistical approach to economic and social sciences. This approach is indeed based on the interchanges among individual actors like gas molecules of Boltzmann thermodynamics and the related notion of system *stability at equilibrium* of statistical mechanics, and therefore based on the related notion of *information asymmetry*—a notion that is at the basis also of Shannon's statistical notion of information in communication engineering [12]—as the core of market stability. Not casually the 1970 Nobel Prize in economics, P.A. Samuelson—the founder of the prestigious 'MIT School of Economics' counting among its members an impressive list of other Nobel Prizes—dedicated the first two chapters of his momentous textbook *Foundations of economic analysis* to Gibbs' thermodynamics, as the inspiring model of his approach [13]. And not casually the notion of information asymmetry obtained the Nobel Prize in 2001 to G. Akerlof, M. Spence and J.E. Stiglitz for their 'analyses of markets with asymmetric information'. However, an ever-growing usage of the Internet and of automatic computer-based financial exchanges acting worldwide on the markets in a second-fraction timing is evidently reducing this asymmetry, if not destroying at all [14]. The physical frame of reference is no longer 'a gas' of individual economical agents, but 'a fluid of interacting and ever changing 'condensates' of economical agents. Therefore, no longer the statistical mechanics, but the *condensed matter physics,* dealing with dissipative systems, persistently acting in *far-from-equilibrium conditions,* must be the frame of reference for modelling the actual situation of financial markets. In a word, the new situation makes obsolete the classical statistical techniques of financial analysis and prevision. This theoretical failure made the market recurrent crises as unpredictable as stronger earthquakes during a persistent earthquake swarm. In other terms, the lack of suitable means of control and prevision over the actual financial jungle of markets makes them so vulnerable to financial speculations, and then our economic systems, and our democracies too, so fragile, because effectively out from any possible control and political or ethical orientation towards the common good. Roughly speaking, the modern optimistic confidence into the 'invisible hand' acting on markets of Adam Smith risks to be today without any mathematical foundation. As Samuelson rightly emphasized at his time, this was Gibbs' statistics supposing a stability at equilibrium, by the

reciprocal compensation of the 'forces' in the markets. In our 'Communication Age', this hand is often completely paralyzed! Also in this sense, and overall in this sense from the social standpoint, we are living today in a Post-Modern Age.

Therefore, in the next section of this chapter, we illustrate 'the paradigm-shift' occurring in quantum field theory (QFT), and then in quantum computations, before all for dealing with the challenges of condensed matter physics in dissipative quantum systems. At the same time, this paradigm shift is strictly related in theoretical computer science with the research of innovative solutions to the 'big data' issue, and particularly with the challenge constituted by the *infinite data streams* modelling. They are characterized, indeed, by the continuous changes of the inner long-range correlations, and then by the necessity of readapting continuously the 'degrees of freedom', or the 'dimensions', of the computing system representation space. No classical statistical tool can perform such a task, but, on the contrary, it is what characterizes the dynamic principle of the 'doubling of the degrees of freedom' between a system and its thermal-bath in the *coalgebraic modelling* of quantum dissipative systems in the so-called *thermal QFT*. From the mathematical standpoint, the problem is indeed the same. In fact, there exists an evident convergence between the coalgebraic approach in thermal QFT, developed by theoretical physicists during the last 20 years, and the coalgebraic approach to computing systems (automata) interpreted as *labelled state transition systems.* This was developed simultaneously, but till recent years independently, by the theoretical computer scientists, precisely for dealing with the *dynamical* modelling of data stream, in the framework of 'Universal Coalgebra' as general theory of systems, and then outside the Turing paradigm of universality in computations [15].

On the other hand, since this coalgebraic approach to Boolean algebra semantics in computer science is developed in the framework of CT logic, this offers us in the final section of this chapter, for a systematic comparison between the phenomenological and the semiotic approach to the problem of meaning, so to describe more precisely the epistemological role of human consciousness, and its unicity, in our Post-Modern Age.

2. The topological interpretation of quantum field theory and of quantum computing in the framework of the category theory

2.1. The topological interpretation of quantum computing and quantum field theory

Also for solving the just remembered problems of representation and control on data streams, and more generally for solving the computational issues related with the famous 'big data' problems, emerging in any field of contemporary human and natural sciences—for which not only human minds, but also the formal apparatus of standard logic and mathematics are impotent—a new generation of quantum computing systems is object of the most advanced research.

This improvement is based on the so-called 'topological quantum computing', or 'topological QC' [16, 17], which, on its turn, is based on the operator algebras [18, 19], and then on a

'topological interpretation of quantum field theory', or 'topological QFT' [20], as fundamental theory of condensed matter physics, as well as of elementary particle physics 'beyond the Standard Model'.

The experimental proof of the insufficiency of the 'Standard Model' (SM) as theory about the ultimate constituents of matter has been awarded by the Nobel Prize in Physics in 2015. Furtherly, the promising results in the realm of topological QFT and topological QC, which led also to the discovery of 'exotic' phases of matter, have been awarded with the Nobel Prize in Physics for this year 2016. This emphasizes the absolute relevance of the research program of topological quantum computing, leading computer science beyond the classical, logistic, 'Turing Universality' principle in computation, in the sense that the topological QC paradigm is wider than Turing's one, because including it. It is based indeed on 'Algebraic Universality', and more significantly for our aims, on a 'Coalgebraic Universality' principle [15].

For understanding intuitively which is the deep paradigm shift in the ontology of physical reality related to QFT, let us start from the illustration of the difference between the mechanical vacuum of Newtonian and Laplacian mechanics, and the quantum vacuum (QV) of QFT (for such a reconstruction, see Refs. [21, 22]).

The QV has to be intended, indeed, as the dynamic substrate of all force fields connecting dynamically everything in the universe, and as the bounded energy reservoir of everything that exists in our universe and even of whichever possible universe in an (hypothetical) multiverse. In the QV ubiquitous present, everything is immersed from 'its inside' (the material constituents), and from 'its outside' (the environment). The same elementary particles constituting the material substrate of whichever physical thing are to be interpreted dynamically, given that their same mass has ultimately a dynamic justification, via the famous 'Higgs field'. Elementary particles, indeed, in the QFT framework are as many 'quanta' of the relative force field, given that, not only the gauge bosons (the massless photons, gluons, the massive W and Z bosons) of the interaction force fields of the SM (respectively, the electromagnetic, the strong and the weak forces), but also the Higgs boson and the relative field, as well as the massive fermions of SM (the quarks and the leptons (neutrinos and electrons)), i.e., the elementary 'building bricks' of the macroscopic bodies have to be conceived in QFT like as many massive or massless quanta of the relative material (fermions) or interaction (gauge bosons) force fields.

Finally, the same macroscopic bodies of our everyday experience, ourselves included, are constituted by 'condensations' of the elementary constituents (molecules, atoms, quarks and leptons, etc.), at different level of matter complexity (see the notion of QV 'foliation'), are depending on as many 'phase coherences' or coherent modes of oscillation of the relative force fields, determining the 'long-range quantum entanglements', and then the macroscopic unity of each body, as well as their reciprocal differences. Each of these 'phase coherence domains' or 'matter phases' depends, via the famous 'Goldstone theorem', which is the core of the Higgs mechanism in QFT, on a 'spontaneous symmetry breakdown' (SSB) of the QV.

Each SSB, in other terms, depends on the 'modes of (phase) coherent oscillations' of some force fields—either the material or the interaction ones. The 'quanta' of these coherent modes are a

third type of non-massive and non-energetic bosons (i.e., non-associated to any specific force field), beside the gauge bosons and the Higgs' one, the so-called 'Nambu-Goldstone bosons' (NGB's). They appear normally in the equations of QFT and are observed, measured and denoted as 'quasi-particles', for their strange properties. They, indeed, disappear without residuals—i.e., without violating the First Principle of Thermodynamics, because they are not 'quanta of energy' like the gauge bosons—with the field phase coherence that they 'order'. In this way, each phase coherence domain is characterized by a univocal 'fingerprint' corresponding to the value of the condensate of NGB's determining this phase. Therefore, they assume different denominations, according to the different phases of matter they determine. For example, in solid state physics, they assume the name of 'phonons', by determining the different phases—liquid, solid or crystalline of materials by breaking the rotational 'Galileian symmetry of molecule mechanical vibrations. Or, they assume the name of 'magnons', because determining in some metals their 'ferromagnetic phase', by breaking the rotational symmetry of the magnetization vectors, orienting them into one only direction.

Roughly speaking, this means that what microscopically links together the molecules of the plastic casing of my mouse, or the molecules of the wood desk on which the mouse is staying, are the different phase coherences of the oscillation modes of their respective material and electromagnetic force fields, ultimately depending on the long-range quantum correlations (entanglements) among these fields. Just as, what distinguishes the different liquid or solid phases of the same material are, respectively, the longitudinal, or the longitudinal and the transversal long-range correlations of the mechanical oscillations of the molecules of that material, 'breaking' the spherical 'Galilean symmetry' of the molecule mechanical vibrations that, on the contrary, holds 'unbroken' in the gas phase of the same material.

Ontologically, the distinction between material and interaction fields with their particle-like (bosonic and fermionic) quanta, on one side in the QV, and, on the other side, the NGB's as quanta of the coherent modes of oscillations of the material fields, emerging from the QV by SSB's like as many 'ordering principles' in the constitution of the complex structure of particles and then of macroscopic bodies, by the principle of QV foliation obviously recall the 'double constitution' matter-form of the Aristotelian ontology of nature. Not only because in QFT like in Aristotelian physics no mechanical vacuum exists, but overall because in this ontology, the 'natural forms' of bodies emerge as *ordering principles,* through the concourse of purely physical causes, from the universal substrate of the 'primary matter', according to the improper modern translation of the Aristotelian term of *próte dynamis*, 'primary dynamism'. The connection of the *próte dynamis* with QV as dynamic substrate of any physical entity is straightforward in this framework. This "education" of natural forms from the 'primary dynamism' of matter is, indeed, the core of the Aristotelian 'causal justification' of the physical forms (natural kinds) in nature, against the *dualism* of the Platonic ontology of nature where 'forms' are inserted from the outside of matter intended in a purely mechanistic way. Of this extrinsic character of 'forms' as to 'matter' the Galileian-Newtonian ontology is the 'representational counterpart', because banishing the forms in physics into the *mathematical formalisms* of a representational mind, modern conceptualist counterpart of the Platonic hyperuranium (see below Section 3 and [22–24]).

2.2. Some epistemological consequences

Anyway, QFT is evidently an ontological paradigm shift as to the mechanistic one of the modern Newtonian and Laplacian physics, conceiving the physical body as 'isolated' in the *mechanical vacuum*. This ontology has in the solipsism of the Kantian 'transcendental subject' the necessary counterpart for justifying a 'representational epistemology', in which truth is based on *evidence*, as Descartes first realized, and therefore it is based on the self-consciousness of some knowing subject.

In this way, the ontological truth is based on a consciousness state ('evidence'), according to the Modern Transcendental of Knowledge of Descartes, Newton and Kant. At that time, at the down of Modernity, John Poinsot's (1589–1644) opposed to this approach a 'proto-semiotic' interpretation of Aristotle's and Aquinas' logic and ontology, according to which truth depends on an identity of structure (effectively a 'homomorphism' or bijective mapping) on causal basis, from the formal structure of a thing—that, as such, is always an element of *a natural kind*[2]—onto the formal structure subject-predicate of a sentence referring to it. As far as such a correspondence becomes aware in humans, we have a 'conscious knowledge'. In this way, Poinsot anticipated the post-modern primacy of language over knowledge that, for using a famous Heidegger expression, was a *Holzweg* during the Modern Age, re-proposed independently at the end of Modernity by Ch. S. Peirce [5, 25].[3]

Poinsot, indeed, in his treatise *De Signis,* the first treatise of semiotics in the Modern Age [26], individuated a third ontological type of relations beside the classical 'real' (causal or physical) and 'rational' (mental) relations of the Scholastic tradition: the 'linguistic relations' (*relationes secundum dici*). In Poinsot's proto-semiotic framework, indeed, like in Aquinas' one, the truth of the sentence depends on its causal relation from the things, so that the *logical structure* subject-predicate of the sentence 'mirrors dually' the *causal structure* 'species-thing' (or 'genus-species'). The human knowledge, therefore, is the conscious self-representational after-effect of such an *onto-logical* foundation of truth, so to vindicate a primacy of *ontology over epistemology*. In this way, in human knowledge, the real 'thing' becomes an 'object-for-a-subject', in the sense of awareness of the outcome of a relational pre-conscious foundational process of truth in language. In this way, Poinsot gives us a semiotic relational interpretation of Aquinas' fundamental statement that is at the basis of his ontological theory of truth, per which: 'being is the first known by the intellect… however knowledge is a sort of effect of truth (*effectus quidem veritatis*)' (Aquinas, *Quaestione Disputatae De Veritate,* I,1). The following scheme exemplifies Poinsot's theory.

From this scheme, it is evident that this 'proto-semiotic' foundation of truth in language consists in the unconscious representation (mapping) of *real relations* from a thing, into the *logical ones* of a predicative sentence (= 'transcendental relations', in the figure), by a *reflexive*

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[2]For example, a horse is a member of the genus of mammalians on a causal basis, in the sense that the members of a given species/genus share the same causal web justifying their existences. Effectively, it is well-known that in genetics the members of a given species share common sequences of DNA, so that from the DNA is possible to reconstruct the phylogenetic history of a given species.

[3]Effectively, Peirce did not know Poinsot's works, even though both depend on the teaching of the works of the so-called *Cambricenses* teachers [5]. For this reason, along all his career, Peirce defined himself as a 'Scholastic realist'.

relation (= first 'rational relation', in the figure). This has the double role of *reversing* the arrow directions between the first two so to make them *dual* as to each other, and of *preceding* the further *self-reflexive* relation (= second 'rational relation', in the figure), by which the 'thing' is represented as an 'object' in a self-conscious mind.

The connection of this naturalistic ontology of knowledge with QFT as fundamental physics of the cognitive neuroscience and of topological QC will be discussed in the following. On the contrary, here it is important to emphasize the strict relationship between Poinsot and Peirce that historically makes of Poinsot the first philosopher who, in the history of Western thought, defined the 'triadic' structure of a *signifying* relation, i.e., of a sign. This idea is hidden in the definition by Poinsot of a 'relation in language' (*relatio secundum dici*) as a *transcendental relation* (see **Figure 1**), in two senses (see, Poinsot, *De Signis,* 574b14–575a19. In [26, p. 82]):

1. Because it does not belong to the category of relations that are all *dyadic,* that is, they are a 'being-to'(*esse ad*), whereas a 'sign' is a 'being-for' (*esse per*), and therefore it is a *triadic relation*;

2. Because a linguistic relation can apply to all the other categories and then *it transcends them.*

In this way, the 'proto-semiotic' ontology of Poinsot consists in enriching the Western ontology, not only with a new 'ontological category' of beings, the *signs,* beside the *rational* ones in mind, and the *real* ones in physics. They are a new type of *relations,* the *semiotic relations*, designed by Poinsot with the term of '*transcendental* relations', because of their fundamental role in language of connecting whichever 'category' of beings and relations. Specifically, they are able to connect 'rational relations', relating *mental* 'objects' (concepts) among themselves, with 'real relations' (causes), relating *natural* 'things' among themselves, via the power of signs of 'expressing' (being-for) both rational 'objects' and natural 'things'. Therefore, they are able to extend the function of 'signifying' also to the other two ontological categories, of 'objects', as signifying *things*, and to 'things' (effects) as signifying '*other things*', i.e., *causes*, e.g., a healthy blood as signifying a healthy body, so to effectively *bridging* 'objects' with 'things', and then 'rational relations' (mental relations) with 'real relations' (causal relations).

All the richness of this proto-semiotic ontology gets lost with the modern epistemological foundation of truth, so to confirm that, if the Middle-Age was the 'dark age' for physical and
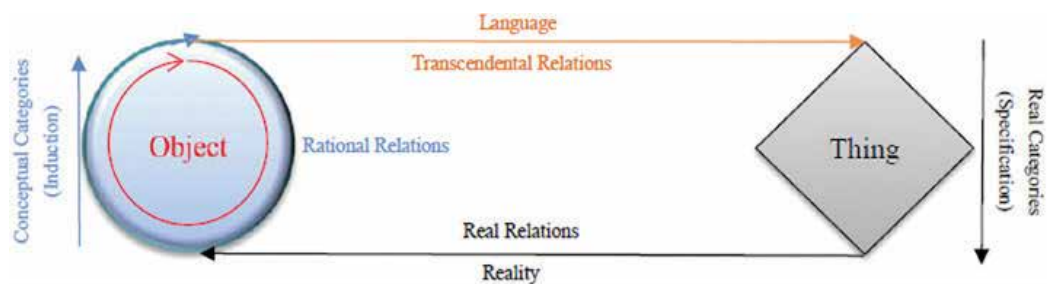

Figure 1. Poinsot's scheme of the foundation of truth in language as preceding its knowledge.

mathematical sciences, the Modern Age was the 'dark age' for ontological and metaphysical sciences. In fact, the epistemological foundation of truth on 'evidence' of modern philosophy and science, from Galilei, to Descartes, to Newton and Kant, moves the real things, reduced to 'objects-for-a-subject', and their real and linguistic relations reduced to 'rational relations' in mind, in the double sense:

1.   Of the rarefied, fascinating realm of the human 'abstract thought' of the pure mathematics evidences; and

2.   Of their 'observer-related' application to empirical evidences, according to this modern epistemological interpretation of the Galileian method, in which mathematics precedes and guides the empirical observation.

Effectively, the self-representational 'evidence' as foundation of truth in Descartes and his followers 'cuts', because of its self-representational (self-conscious) nature, any relationship with the 'outer reality', just as the Newtonian calculus has 'to cut' any dynamic interaction of a mechanical system in the mathematical formalism of calculus, by supposing the abstract *mechanical vacuum*, for stopping the derivative order at the second one, by the 'inertia principle'. That is, for considering the acceleration as a constant, and so granting the abstract integrability of a function, and then the geometrical (kinematic) representation of the dynamics of a mechanical system.

S. de Laplace extended the Newtonian method to "many body physics", where, because of the many bodies simultaneously interacting, their isolation from any interaction can be abstractly granted only by supposing the so-called "asymptotic condition". It constitutes the core of the Laplacian "perturbative methods". Synthetically, in the (false) supposition that the properties of an isolated and of an interacting body are "always" the same, each of the components of a many body system is studied in an asymptotic condition, i.e., at an infinite spatio-temporal distance from each other, so to grant their isolation condition. Afterward, this characterization is applied in the interaction condition, interpreted as a "perturbation" of the asymptotic one. This formalism is the core of the modern statistical mechanics, extending the Newtonian mathematical analysis from geometry to the matrix algebra. Afterward, L. Boltzmann and J. W. Gibbs extended this method to the statistical thermodynamics of systems stable at equilibrium (gases). Finally, J. Von Neumann extended the matrix formalism of statistical mechanics to the formalism of Hilbert spaces in quantum mechanics (QM), so to make of the asymptotic condition the core of R. Feynmann's diagram formalism of QFT, interpreted as a "second quantization" with respect to QM.

Let us deepen, therefore, the core of the alternative paradigm of thermal QFT, we illustrated intuitively before [23]. The coalgebraic formalism underlying its modelling, both in physics and in computer science, is able indeed not only to recover all the richness of the semiotic ontology of Poinsot, but to give it the support of the formal rigour of the axiomatic method in logic and mathematics, as we see in the following of this chapter.

2.3. QFT as a thermal field theory and its topological modelling

In fact, historically and scientifically, which are the origins of the QV notion, and why they are so fundamental and unavoidable in QFT? QV is the only possible explanation at the

fundamental level, of the *Third Principle of Thermodynamics* ('The entropy of a system approaches a constant value as the temperature approaches zero'). Indeed, the Nobel Laureate Walter Nernst first discovered in 1912 that for a given mole of matter (namely an ensemble of an Avogadro number of atoms or molecules), for temperatures close to the absolute 0, T_0, the variation of entropy ΔS would become infinite (by dividing by 0).

Nernst demonstrated that, for avoiding this catastrophe, we must suppose the molar heat capacity C is not constant at all, but vanishes, in the limit $T \to 0$, so to make ΔS finite, as it must be. This means, however, that near the absolute $0°K$, there is a mismatch between the variation of the body content of energy and the supply of energy from the outside. We can avoid such a paradox, only by supposing that such a mysterious inner supplier of energy is the vacuum. This implies that the absolute $0°K$ is unreachable. In other terms, there is an unavoidable fluctuation of the elementary constituents of matter. The ontological conclusion for fundamental physics is that we cannot any longer conceive physical bodies as isolated, because *they are always intrinsically 'open' to the thermal fluctuations of QV*. This means that the usage of the asymptotic condition of perturbative methods that by 'Feynman's diagrams' is at the core of the Standard Model (SM) formalism is, in some proper sense, 'falsifying' the intimate thermal nature of the physical reality. In the SM, indeed, the mechanistic prejudice still holds in interpreting *fermions* as 'particles', and *gauge bosons* (photons, gluons, and W and Z bosons), as quanta of the three fundamental force fields (electromagnetic, strong and weak forces, respectively), by which fermions interact among themselves. On the contrary, in thermal QFT, both fermions and gauge bosons must be interpreted as quanta of the relative force fields, of *material* force fields (fermions) and of *interaction* force fields (gauge bosons), respectively.

In this picture, the QV, differently from the mechanical vacuum separating the inert particles of the Newtonian mechanics, emerges as a dynamic continuum of force fields connecting everything in nature, so to justify a topological representation of QFT [20]. This explains also the progressive disaffection of physicists towards perturbative methods when dealing with the many unresolved problems of the 'physics beyond the SM'. Anyway, for this discovery, eliminating the notion of the 'inert isolated bodies' in the mechanical vacuum of the Newtonian mechanics, Walter Nernst is a chemist who is one of the founders of the modern quantum physics.

All this is, indeed, the starting point of S. Umezawa's 'thermo-field dynamics' (TFD), as an alternative interpretation of QFT in quantum thermodynamics, with respect to its statistical mechanics interpretation, because vindicating the primacy of dynamics over kinematics in physics [27, 28]. During the last 20 years, however, by the integration of TFD with the fundamental 'Goldstone Theorem' [29], and then with the infinitely many *spontaneous symmetry breakdowns* (SSB's) of the QV, all compatible with the QV ground state and that are at the basis of the Higgs mechanism, Umezawa's TFD formalism received an essential improvement. This goes into the direction of the topological QFT, because of the 'dynamic rearrangement of symmetries' that each SSB intrinsically implies. Let us see more deeply this essential point [21].

Generally, since when they were theoretically defined by Goldstone's theorem, SSBs have an essential role in the local gauge theory by Higgs field, because to each SSB corresponds the emergence of 'long range quantum correlations (entanglements)' we previously designed as

'phase coherence domains' of the force fields [30]. In fact, in QFT, the 'Stone-Von Neumann Theorem', at the basis of Von Neumann's classical formalism for QM [31], *per se* does not hold. This theorem states that, for systems with a finite number of degrees of freedom, which is always the case in QM, the representations of the canonical commutation relations (CCRs) are all 'unitarily equivalent as to each other'.[4] On the contrary, in QFT, because of the fundamental 'Haag Theorem' (1959), and of the related infinitely many SSB's of the QV [29], the number of the degrees of freedom is not finite, and infinitely many unitarily inequivalent representations of the canonical commutation (bosons) and anti-commutation (fermions) relations exist in the QV. This means that in QFT based on statistical mechanics, the choice of the finite 'orthonormal basis of the Hilbert space', *per se* infinite dimensional, depends on the observer. This led to the never ending epistemological discussions about the 'objectivity' of QM, and of QFT (quantum thermodynamics included) as far as both based on statistical mechanics and of its asymptotic equilibrium condition (the so-called 'KSM-condition') [32].

In TFD sense, on the contrary, 'QFT can be recognized as an intrinsically thermal quantum theory' [21, p. ix], because, for the Third Principle of Thermodynamics, all quantum systems are energetically open to QV fluctuations in the background. Of course, each open QFT system can recover its Hamiltonian character, because of the necessity of anyway satisfying the energy balance condition ($\Delta E = 0$) of each QFT system with its thermal-bath. This can be represented by 'doubling' each state of the Hilbert space with the correspondent 'entangled state' of the thermal-bath, each doubled state representing a given 'phase coherence' emerging from the QV by an SSB.

This is the core of the fundamental principle of the 'doubling of the degrees of freedom'(DDF) of thermal QFT, which is essential also for modelling quantum computing architectures based on DDF as a dynamic 'deep learning' strategy [33]. The essential improvement as to early Umezawa's formalism is that such an openness of a QFT system can be mathematically formalized by the 'algebra doubling', between a q-deformed Hopf coalgebra (thermal-bath) mapping its structure onto its 'dual' q-deformed Hopf algebra (system), where q is a thermal parameter [22], intrinsically related with the 'Bogoliubov transformation', appearing in any process of particle 'creation-annihilation' in quantum thermodynamics. This means that in this topological approach to thermal QFT, the dynamics itself, and not the observer, determines the finite 'orthonormal basis of the doubled Hilbert space' by the DDF principle [20, 33].

To conclude, in QFT, the Heisenberg uncertainty relation of QM between the *statistical* wave and particle representations of a quantum system must be rewritten as relating *dynamically* the uncertainty on the number of the field quanta with the uncertainty on the field phase, namely:

$$\Delta n \Delta \varphi \geq \varphi(\hbar) \tag{1}$$

where n is the number of quanta of the force field, and φ is the field phase. If $\Delta n = 0$, φ is undefined, so that it makes sense to neglect the waveform aspect in favour of the individual,

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[4]We recall that at the basis of QM formalism, there exists the fundamental D. Hilbert's discovery that the canonical variables of classical mechanics (the position q and the momentum p), which *per se* do not commute with each other because of the uncertainty principle, however commute each with the Fourier transform of the other. In this way, each pair of them constitutes a CCR.

particle-like behaviour. On the contrary, if $\Delta\varphi = 0$, n is undefined because an extremely high number of quanta are oscillating together according to a well-defined phase, i.e., within a given phase coherence domain. In this way, it would be nonsensical to describe the phenomenon in terms of individual particles behaviour, since the collective modes of the force field prevail.

In QFT, there is, therefore, a duality between two dynamic entities: the fundamental force field phase and the associated quantum particles that are simply the (fermionic/bosonic) quanta of the associated (material/interaction) field. In such a way, the long-range quantum entanglements associated with SSBs, and determining a 'phase coherence domain' into the QV, do not imply any odd relationship between particles like in QM. Entanglements are simply the expression of the continuous, topological character of force fields, of their phases and of their relations. To sum up, according to such a view, Schrödinger's wave function of QM appears to be only a statistical, observer-related, 'blanket' of a finest structure of the dynamic nature of reality.

Of course, the *probability measures* associated with this dynamic interpretation of QFT are related with the so-called 'Wigner function'. The main difference with Schrödinger wave function is that not only the former, differently from the latter, is defined on the phase space of the system. What is much more fundamental is that the Wigner function uses the notion of *quasi-probability* [34], and not the notion of probability of the classical Kolmogorov axiomatic theory of probability [35]. Indeed, the notion of quasi-probability allows regions integrated under given expectation values *do not represent mutually exclusive states*, because of the reinterpretation of the uncertainty principle, so to violate the first axiom of Kolmogorov's theory. That is, the separation of variables in such distributions is not fixed, but, as it is the rule in the case of phase transitions (think, intuitively, at the phase transition between the gas, the liquid and the solid states in condensed matter), can evolve dynamically, even though, via the DDF principle, our representation can match this evolution, by the associated measure of the *minimum of the free-energy* [20, 33].

2.4. From set theory to category theory as universal language for mathematics

This last evidence introduces us in the necessity of dealing with a change of perspective also in fundamental mathematics and logic. Topological QFT and topological QC are indeed generally based on the 'Algebraic Universality' given that, following an intriguing analogy, in quantum mathematics sets are represented by Hilbert spaces, subsets by Hilbert space sub-algebras, and instead of functions over sets, we have operators over Hilbert spaces [36]. This change of perspectives contributed to the affirmation of Category Theory (CT) as a universal language for mathematics and logic, in a proper sense 'more general' than set theory.

Using CT, indeed, it is possible to discover and to define relationships among different theories that it would be impossible discovering and defining otherwise. In a proper sense, CT is a sort of axiomatic outcome of Peirce's intuition of a purely relational categorical approach to theories, also because of CT native dependence on the algebra of relations, of which Peirce was the pioneer. Let us sketch briefly some notions of CT, using a sort of synthetic handbook of CT, inserted as the introductory paper, explicitly thought for physicists and philosophers [37], in a collection of papers devoted to apply several CT structures, particularly *coalgebras*, in topological QFT, string theories included [38].

The principal difference as to set theory is that in CT the *primitives* are: (1) *morphisms* or *arrows*, *f, g*—intended as a generalization of notions such as 'function', 'operator', 'map', etc.; (2) the *compositions of arrows*, $f \circ g$; and (3) two 'mappings', *dom*($\bullet$) and *codom*($\bullet$) assigning a domain and a codomain to each arrow. In this way, even set elements in CT are to be considered as domain-codomains of morphisms, and, more generally any 'object' *x* in CT corresponds to the domain of a reflexive morphism I_x, i.e., to an 'identity' relationship.

Therefore, any *structure-preserving collection* of 'objects', 'morphisms' and of the two 'mappings' *dom*(*f*) and *cod*(*f*), assigning to each morphism *f* its domain-codomain of objects, constitutes a *category* in CT. In this sense, fundamental examples of categories in mathematics are: **Set** (sets and functions), **Grp** (groups and homomorphisms), **Top** (topological spaces and continuous functions), **Pos** (partially ordered sets and monotone functions), **Vect** (vector spaces defined on numerical fields and linear functions), etc. Particularly, the category of **Pos** is fundamental in logic. Indeed, partial ordering is a structure of ordering relations, ≤, among sets satisfying simultaneously:

- $x \leq x$ (Reflexivity).

- $x \leq y \wedge y \leq x \Rightarrow x = y$ (Antisymmetry).

- $x \leq y \wedge y \leq z \Rightarrow x \leq z$ (Transitivity).

The structure of 'total ordering' of sets, and the relative category **Tos** of totally ordered sets, satisfies Antisymmetry and Transitivity, but instead of Reflexivity, it satisfies the ordering property:

- $x \leq y \vee y \leq x$ (Totality).

That is, for all sets, an ordering relation is defined. Nevertheless, the category **Tos** lacks in an 'object' as to **Pos,** because the ordering relation ≤ that **Tos** uses is no longer an object in it, and since does not satisfy any longer reflexivity like in **Pos**. Therefore, **Tos** is a subcategory of **Pos.** In fact, fundamental posets are the real number set ($\mathbb{R}$,≤), and the power set $\mathcal{P}$ of a given set *X* ($\mathcal{P}$ (*X*),⊆).

Another fundamental notion of CT is the notion of *functor F*, that is, a 'morphism between categories' sending all the objects, arrows and compositions from a category $\mathcal{C}$ into another $\mathcal{D}$, i.e., $F : \mathcal{C} \rightarrow \mathcal{D}$ so to justify a *homomorphism*—corresponding in set theory to a 'bijective mapping'[5]—between the categories $\mathcal{C}$ and $\mathcal{D}$. Of course, for each category $\mathcal{C}$, there exists an *endofunctor* mapping a category onto itself: $\mathcal{C} \rightarrow \mathcal{C}$. Moreover, the application of the functor can be 'covariant', if it preserves all the objects and the directions of morphisms and the orders of

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[5]For sake of completeness, to an 'injective mapping' in set theory corresponds the functorial mapping of *monomorphism* in CT, and to a 'surjective mapping' an *epimorphism*. What is nice in using CT as a metalanguage of mathematics is that the meta-notion of 'functor' as 'morphism of morphisms' is not *per se* a second order notion, as they are in logic the notion of 'function of functions' or 'class of classes'. That is, by CT, we can have a universal axiomatic metalanguage of logical and mathematical theories that does not imply *per se* any quantification over constants of the object-language, so to avoid all the problems related with the incompleteness of the higher order predicate calculus—even though it is possible to represent in CT higher-order logics. On the contrary, we can formalize in CT logic the logical quantifiers of the predicate calculus like as many *adjoints* of an algebraic structure over the power-set of a given set, so 'to extend to an algebraic form the usual Tarski model-theoretic semantics for first-order logic' [37, p. 45].

compositions between the two categories. On the contrary, the application of a functor G is 'contravariant' if it preserves all the objects, but reversing all the directions of the morphisms (i.e., from $A \rightarrow B$, to $GA \leftarrow GB$), and the orders of the compositions (i.e., from $f \circ g$ to $Gg \circ Gf$). In this case, the target category of the functor is the opposite as to the source category. That is, a functor G is contravariant, if $G : \mathcal{C} \rightarrow \mathcal{D}^{\mathrm{op}}$.

The notion of 'opposite category', per which a category $\mathcal{C}$ is dual as to its opposite $\mathcal{C}^{\mathrm{op}}$, leads immediately to the fundamental *principle of duality*[6] in logic, according to which a statement S is true in/about $\mathcal{C}$ if and only if its dual S^{op} obtained from S by reversing all the arrows is true in/about $\mathcal{C}^{\mathrm{op}}$. That is, S and S^{op} are 'dually equivalent', i.e., $S \leftrightarrows S^{\mathrm{op}}$, which is different from the ordinary equivalence between statements defined in/about the same category, i.e., $S \leftrightarrow S'$. What is important to emphasize for our aims is that in computational set theoretic semantics, the dual category of **Set$^{\mathrm{op}}$** is more significant than **Set**, given that a generic conditional in logic 'if…then', e.g., 'for all x', if x is a horse then it is a mammalian, is true if and only if the 'mammalian set' dually includes the 'horse set' with all its subsets. Therefore, the semantics of a given statement is set theoretically defined on the power set $\mathcal{P}(X)$ of a given set X. Categorically, indeed, the power set functor $\mathcal{P}$ is a covariant endofunctor **Set** $\rightarrow$ **Set,** mapping each set X to its power set $\mathcal{P}(X)$ and sending each function $f : X \rightarrow Y$ to the map sending $U \subseteq X$ to its image $f(U) \subseteq Y$, that is:

$$X \mapsto \mathcal{P}(X), \ (f : \ X \rightarrow Y \ \mapsto \mathcal{P}(f) \ := \ S \mapsto \ \{f(x) \mid x \in S\} \tag{2}$$

vice versa, the contravariant set functor $\mathcal{P}^{\mathrm{op}}$: **Set$^{\mathrm{op}}$** $\rightarrow$ **Set** sends each function $f : X \rightarrow Y$ to the map which sends $V \subseteq Y$ to its inverse image $f^{-1}(V) \subseteq X$, but, of course, preserving all the objects. Therefore,

$$\mathcal{P}^{\mathrm{op}}(X) \ := \ \mathcal{P}(X); \mathcal{P}^{\mathrm{op}}(f : \ X \rightarrow Y) \ \mapsto \mathcal{P}(Y) \rightarrow \mathcal{P}(X) \ := T \{x \in X \mid f(x) \in T\} \tag{3}$$

Moreover, other useful categorical dual constructions can be significantly formalized in CT that we cannot define here, but that have an immediate significance for us because both the topological formalism of quantum physics and of quantum computation are plenty of exemplifications of their usage. For instance, the notions of 'left' and 'right adjoints' of functions and operators, the notions of 'universality' (uniqueness) and 'couniversality', of 'products' and 'coproducts', of 'limits' and 'colimits' interpreted, respectively, as 'final' and 'initial' objects of two categories related by a third category of 'indexing functors', so to grant the mapping, via a 'diagonal functor', of all the objects and morphisms of one category into the other. Practically, all the objects and the operations that are usefully formalized in set theory, and then in calculus and logic—including the 'exponentiation' operation for forming function spaces, and the consequent 'evaluation function' over function domains—can be usefully formalized also in CT, with a significant difference, however. Instead of considering objects and operations for what they 'are' as it is in set theory, in CT we are considering them for what they 'do' [37, p. 53],

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[6]Effectively, the notion of *duality* is well-known in logic, mathematics and physics that are plenty of dual notions. For example, in mathematics, a function and its inverse are dual, just as 'and' and 'or' in logic, according to the De Morgan laws, or a function and its Fourier transpose in physics. See [66] for a survey.

so to fulfil in formal way the primacy of *pragmatics* over syntax and semantics that the semiotic interpretation of logic by Moore borrowed from his teacher Peirce. To conclude, CT significantly completes in an axiomatic way that is absolutely lacking in Peirce's approach—and this constitutes its fundamental weakness—Peirce's 'pragmatic' approach as a research programme for formal logic and mathematics, in terms of a 'formal semiotics'.

2.5. An a'pplication of CT logic to quantum physics and quantum computing

Coming back to topological QFT an QC in the light of CT notions just illustrated, two fundamental categories we met already in Section 2.3, and that can be made dual for the contravariant application of the same functor Ω are those of coalgebras, $\mathcal{A} \to \mathcal{A} \times \mathcal{A}$ and of algebras, $\mathcal{A} \times \mathcal{A} \to \mathcal{A}$, given that often they are not dual at all. This latter is the case, for instance, of fundamental structures in QM like *Hopf algebras,* characterizing all the calculations over any lattice of quantum numbers. A Hopf algebra H is indeed a 'bi-algebra', because it is characterized by two types of operations, i.e., *coproducts* (coalgebra: $H \to H \times H$) and *products* (algebra: $H \times H \to H$), which are both *commuting* and defined over a *field K* with a *K*-linear *map S*: $H \to H$, or *antipode.* This is evidently a *covariant* mapping, i.e., a vectorial covariant mapping sending commuting *coproducts* over commuting *products*, and *counits* ε over *units* η, so that the following diagram of **Figure 2** commutes:

$$H \otimes H \xrightarrow{S \otimes \mathrm{id}} H \otimes H$$

$$\Delta \qquad \nabla$$

$$H \xrightarrow{\varepsilon} K \xrightarrow{\eta} H$$

$$\Delta \qquad \nabla$$

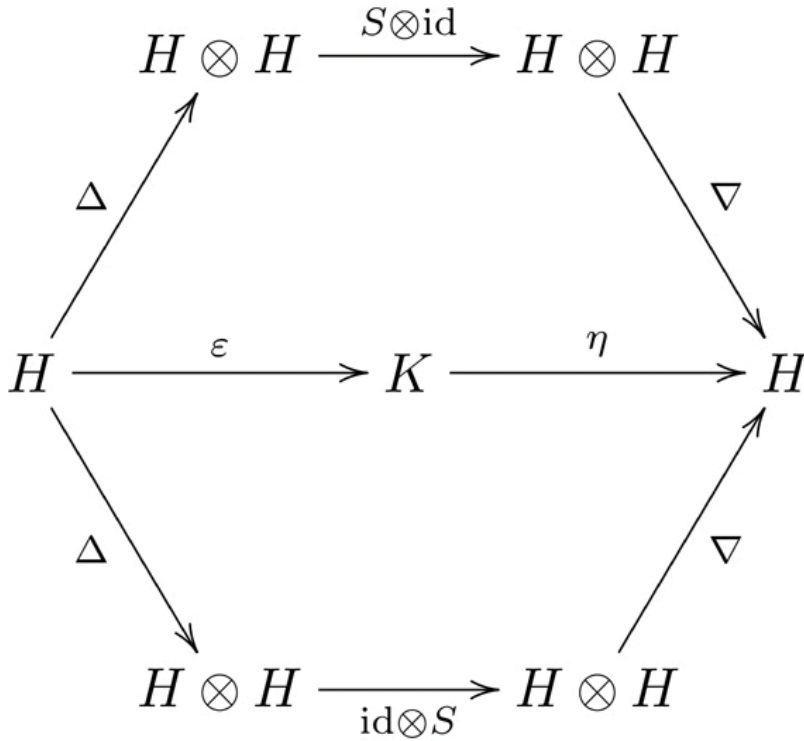$$H \otimes H \xrightarrow{\mathrm{id} \otimes S} H \otimes H$$

Figure 2. Commuting diagram of a Hopf algebra *H.*

In this way, any Hopf algebra is 'self-dual'—in the sense that the dual of a Hopf algebra is always a Hopf algebra, as expressed by the symmetry of the above diagram—just as any Hilbert space, but also like any Boolean algebra are. Now, the role of a Hopf bialgebra in QM calculations over a lattice of quantum numbers emerges immediately when we consider that the 'algebraic half' of the Hopf bialgebra, $H \times H \to H$, applies when we have to calculate, for instance, the energy of a single particle, whereas the 'coalgebraic half', $H \to H \times H$, applies when we have to calculate the total energy of two particles in the same quantum state (coproducts are effectively sums). In this case, the commutativity also of the coproducts makes perfectly sense, because the total energy does not change by interchanging between themselves the two particles that as such, for the Heisenberg uncertainty, are indistinguishable in a quantum state.

The situation changes completely when we deal with dissipative quantum systems of thermal QFT we discussed in Section 2.3, where the total energy concerns the system state and the thermal-bath state that *are not interchangeable at all*. In other terms, in the *q-deformed Hopf coalgebras*—where the 'deformation parameter' q breaking the symmetry of the Hopf bialgebra is a *thermal* parameter—the co-products are *non-commutative*, just as the associated 'doubled Hilbert space', where each state of the system is 'mirrored' by a thermal-bath state (the 'tilde state' in the symbolism below), according to the DDF principle introduced in Section 2.3. The q-deformed Hopf coalgebra of a dissipative QFT system, indeed, describes the doubling of the degrees of freedom $a \to \{a \times \tilde{a}\}$ and of the state space $\mathcal{F} \to \mathcal{F} \times \tilde{\mathcal{F}}$ with the operators a and $\tilde{a}$ acting on $\mathcal{F}$ and $\tilde{\mathcal{F}}$, respectively. In this case, in the associated doubled Hilbert space, what are commuting are the associated *operators* $A(\theta), \tilde{A}(\theta)$ [33][7]:

$$A(\theta) = A\cosh\theta - \tilde{A}^{\dagger}\sinh\theta \tag{4}$$

$$\tilde{A}(\theta) = \tilde{A}\cosh\theta - A^{\dagger}\sinh\theta \tag{5}$$

where, θ is the 'angle' of a Bogoliubov transformation, strictly related to the deformation parameter q, and the canonical commutation relations are:

$$[A(\theta), A(\theta)^{\dagger}] = 1, [\tilde{A}(\theta), \tilde{A}(\theta)^{\dagger}] = 1 \tag{6}$$

All other commutators being equal to zero. Eqs. (4) and (5) are nothing but the *Bogoliubov transformations* for the $\{A, \tilde{A}\}$ couple, evidently applied in a *reversed* way, characterizing any *phase transition* of a QFT system, that is, any process of 'creation-annihilation of particles' from the QV, according to the relation (1) above. In other terms, the Bogoliubov transformations provide an explicit realization of the *contravariant mapping* between a q-deformed Hopf coalgebra and its dual q-deformed Hopf algebra, where the 'reversal of the arrows' has an immediate physical significance in the correspondent *reversal of the energy arrow* characterizing the energy balance in any dissipative system.

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[7]Effectively, we are working here in the hyperbolic function basis $\{e^{+\theta}, e^{-\theta}\}$, i.e., on bosons, and not on the circular function basis $\{e^{+i\theta}, e^{-i\theta}\}$ corresponding to fermions [20].

On the other hand, since each dissipative QFT system is characterized by a pair of a q-deformed Hopf coalgebra, *qHCoalg* and a q-deformed Hopf algebra, *qHAlg*, each pair being *univocally characterized* by a different value of the q parameter, it is possible to demonstrate [33] the *dual equivalence* between the category of q-deformed coalgebras, and q-deformed Hopf algebras. In fact, by using in a contravariant way the vectorial mapping on Hilbert spaces related to the Bogoliubov transform T^*, i.e., by using in a contravariant way the endofunctor T characterizing the category **qHCoalg**, we can obtain:

$$\mathbf{qHCoalg}(\mathbf{T}) \leftrightarrows \mathbf{qHAlg}(\mathbf{T}^*) \tag{7}$$

Now, for computer scientists, in general, the categorical duality coalgebra-algebra, for the contravariant application of the same functor Ω, i.e., **Coalg(Ω)** $\leftrightarrows$ **Alg(Ω^{op})**, are important, just as the category of **Set^{op}** as to **Set**, discussed before for the logicians. In fact, the primacy of **Coalg** as to **Alg** depends on the fact that in **Coalg,** we are not constrained like in **Alg** by the necessity that all the endofunctors must be polynomials because of the 'Fundamental Theorem of Algebra'. In this way, coalgebras appear to be more suitable for modelling *non-linear systems*, as far as by a functorial contravariant mapping, they might 'induce' their structure onto dually homomorphic algebraic structures, and specifically on *Boolean Algebras*. Let us deepen shortly this point, also for the strict correlation with quantum computing.

Effectively, one of the pillars of topological QC is M. Stone's *representation theorem for Boolean algebras*. This theorem demonstrates the isomorphism between a Boolean algebra (BA) and a partially ordered set defined over Stone's topological spaces [39], i.e., over spaces sharing the same topology of C^*-algebras. That is, the algebras associated with Hilbert spaces in topological QFT, via the famous GNS construction [19]. Stone's representation theorem associates each Boolean algebra A with a Stone topological space $S(A)$, in the sense of the isomorphism existing between a Boolean lattice A and a partial ordering of *clopen sets*[8] over $S(A)$. It is important to emphasize that the category of Boolean algebras **BAlg** and of the Stone spaces, **Stone**, are dual, in the sense that a monotone function from the Boolean algebra A to the Boolean algebra B is dual to a continuous function in the opposite direction from the Stone space $S(B)$ to the Stone space $S(A)$. Afterwards, in 1988, S. Abramsky demonstrated the dual equivalence, for the contravariant application of the so-called 'Vietoris functor', V, of the category of coalgebras defined on Stone spaces, **SCoalg,** and the category **BAlg**, where the 'Vietoris space' is a vector space by which the mapping from one structure to the other can be formally justified, via the so-called 'Vietoris construction' [40]. In this way, we can say that each Stone coalgebra 'induces' its own structure over the corresponding Boolean algebra, i.e., **SCoalg(V)** $\leftrightarrows$ **BAlg(V^{op})** so that Abramsky's fundamental result is the core of the 'Universal Coalgebra' as general theory of systems [15]. Finally, the clopen sets of **SCoalg** are 'Non-wellfounded' (NWF), that is, they satisfy P. Aczel's non-standard NWF set theory, based on the so-called 'anti-foundation axiom', which refuses the 'regularity axiom' of the standard ZF set theory, so that set *self-inclusion* is allowed, and then *unbounded chains* of set inclusions [41].

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[8]More precisely, the isomorphism is with an *ultrafilter* (or maximal partial ordering of subsets, with the exclusion of the empty-set, of the power-set of a given set, ordered by inclusion) of clopen sets, i.e., of open sets closed by other open sets because defined on intervals of real numbers. For the notion of clopen sets, think, for instance, at the sets associated with points inside a circle, where the only closed sets are the points constituting the circle border, i.e., the circumference.

This means that a 'total ordering' of all sets cannot be justified in this set-theoretic semantics, that is, not all sets are comparable according to the ordering relation (≤). On the other hand, we can always represent in NWF set theory the relationship superset-subset among subsets of a given set by *directed graphs*, where the nodes are subsets, the edges are inclusion relations and the root is the superset. On this basis, P. Aczel demonstrated that in NWF set theory, there exists an ultimate root of all the set directed graphs by his powerful 'Final Coalgebra Theorem' [42]. The final root of all NWF sets is, in fact, like the 'universal class' *V* of the standard set theories, but with a fundamental difference. All the set elements are not actually existing in it, because no total ordering of all sets is here allowed. On the contrary, they can be progressively 'unfolded' from the root as a sequence of sets by the principle of *coinduction* (↓) of set 'reversed orderings' (≥) for a 'final coalgebra', which is obviously *dual* as to the usual *induction* principle (↑) of set 'orderings' (≤) for an 'initial Boolean algebra', but equally effective as method of set definition and proof [15, 43].

All this led J. Rutten to define the principle of *Universal Coalgebra* as dual to 'Universal Algebra', and as general theory of dynamic and computation systems, both modelled as *labelled (indexed) state-transition systems* [15]. This principle allows, indeed, to define the semantics of functional programming on the physical states of the machine, as far as coalgebraically modelled. Moreover, by the construction of the so-called 'infinite state black-box machine', characterized by a 'final coalgebra' for the category of 'diagonal functors' ($\Omega \times \mathcal{I}$), where $\mathcal{I}$ is a set of 'indexes' mapping each coalgebra of a given category onto its final one for the endofunctor Ω [15, 44], it is possible to model computations on (infinite) data streams that, as we recalled at the beginning, is crucial for computer science. In fact, in CT, it is possible to formalize the notion of 'observational equivalence' as dual to the algebraic notion of 'equivalence by congruence' [44]. This notion is evidently important also for quantum physics, given that, because of Heisenberg uncertainty principle, the computations can be performed not on states, per se, but only on some 'state observables', effectively on the operators over Hilbert spaces.

To conclude, it is possible to demonstrate that the category of **q-HCoalg** satisfies the construction of the 'infinite state black-box machine' for modelling in computer science the notion of 'QV-foliation' characterizing the coalgebraic interpretation of thermal QFT illustrated above. Indeed, the set of q deformation parameters gives us the set $\mathcal{I}$ of indexes for the endofunctor T characterizing the category **q-HCoalg** [33]. This evidence not only explains why one of the most significant experimental confirmation of thermal QFT is the modelling of 'long-term memories' or 'deep-beliefs' in cognitive neuroscience that we discuss in the concluding section. It also opens the way to use the DDF principle for dealing with the issue of the so-called 'deep-learning' as to infinite streams in quantum computing. Effectively, we are prototyping in Italy, by the nanotechnology labs of the National Research Council (CNR) in Bologna, a specific architecture of optical quantum computer modelled on these principles [33].

3. Conclusions: consequences for the epistemology

What is highly significant in the coalgebraic modelling of dynamic systems, and of their logic I just illustrated, is that in conductive reversed (≥) partial orderings, as far as defined on NWF sets where no total ordering is allowed, instead of using the usual transitive rule in the ordering by inclusion relation: $((x \supseteq y \wedge y \supseteq z) \rightarrow x \supseteq z)$ that as such supposes a 'linear' ordering,

with 'jumps' between ascendants and descendants, and then a *total ordering* (see Section 2.4), we can use, in the 'set unfolding' process by coinduction from the root (superset), the 'weaker' Euclidean transitive rule: $((x \supseteq y \wedge x \supseteq z) \rightarrow y \supseteq z)$, or $((x \supseteq y \wedge x \supseteq z) \rightarrow z \supseteq y)$.

Moreover, because both $(y \supseteq z)$ and $(z \supseteq y)$ are allowed in inclusions following the Euclidean rule of transitivity, it is possible to generate, by coinduction from the same root, *equivalence classes of sets*, because of the antisymmetric rule characterizing any partial ordering. In fact, because no total ordering holds, it is possible that from one superset, different inclusion paths following the Euclidean rule derive, like in an evolutionary tree by successive non-linear 'bifurcations', so that, as it must be in each partial and not total ordering, some subsets are not comparable by an ordering relation $(\leq)$, even though, ultimately, sharing the same root. They belong indeed to different inclusion paths. In this way, properly, a superset here only 'admits' $(\ni)$ not 'includes' $(\subset)$ subsets. Just it happens in biology where properly the 'mammalian' root 'admits' not 'includes' as its own subsets 'horses', 'cats', 'dolphins', etc., given that they derive from the same root, but following different and reciprocally irreducible 'unfolding' (evolutionary) paths.

Finally, it is evident that in coalgebras defined on NWF-sets, it is possible to formalize also modal logics [45], as Abramsky first emphasized in his visionary contribution of 1988, and then S. Moss demonstrated (see [40, 46], and for updated syntheses [44, 47]). This means that in coalgebraic logic, we can develop a first-order *modal semantics* of Kripke models—as distinguished from second-order modal semantics for Kripke frames—according to the notion of 'local truth' [48], based on the notion of *dual equivalence* $(\leftrightarrows)$ by a *bounded morphism* $\left(\xleftarrow{\rightleftarrows} \right)$, i.e., by a contravariant functorial mapping between Kripke models. What, intuitively, all this means for our aims is that, because modal coalgebras admit only a *stratified (indexed) usage* of the necessity operator □ and of the universal quantifier ∀, since a set *actually* exists as far as effectively *unfolded* by a co-inductive procedure, the semantic evaluations in the Boolean logic effectively consist in a *convergence* between an inductive 'constructive' (↑) procedure, and a co-inductive 'unfolding' procedure (↓). Namely, they effectively consist in the superposition *limit/colimit* between two concurrent inductive/coinductive computations. This is the core of Abramsky notion of *finitary objects* as 'limits of finite ones', definable only on NWF sets, finitary objects that according to him are the most proper objects of the mathematical modelling of computations [40]. If we come back to Poinsot's proto-semiotic scheme of **Figure 1** in Section 2.2, we realize that the coalgebraic logic is a formal fulfilment of this intuition at the down of Modern Age.

More generally, indeed, we can apply it not only to mathematical logic, but also to philosophical modal and intensional logics, according to the programme of 'formal philosophy' (formal ontology, formal epistemology, formal ethics, etc.) with evident applications to the computational simulation of intentional tasks, as far as they can be modelled only in intensional logics, and then in computational systems not based on the Turing paradigm, just like also human brains are [49, 50].

Effectively, as far as their fundamental physics obeys a thermal QFT like any biological system, they obey a 'Coalgebraic Universality' principle [15] in their computations [33], just as it holds in human brains during intentional tasks. It is indeed not casual that during the last ten years, the QV-foliation in QFT has been successfully applied to solve dynamically the capacity problem of the long-term memories—namely, the 'deep beliefs' in the computer science

jargon—in the living brain, interpreted as a 'dissipative brain', i.e., 'entangled' with its environment (thermal-bath) via the DDF formalism [24, 51–53].

In a formal ontology based on the semiotic naturalism—that is a coalgebraic modal logic based on thermal QFT—all this, roughly speaking, means that it is *logically* true that the *(sub-)class* of horses is a *member* of the *(super-)class* of mammalians *iff, dually,* it is *ontically* (dynamically) true that a *co-membership* of the *species* of horses to the *genus* of mammalians occurs, from some step n onward of the universe evolution (= 'natural unfolding' of a biological evolution tree). That is:

$$\Box_{\forall n > m} \left(\underbrace{horse \in mammmalian}_{\text{Boolean Algebra}(\Omega*)} \quad \underset{\overrightarrow{}}{\overleftarrow{}} \quad \underbrace{horse \ni mammalian}_{\text{Stone Coalgebra}(\Omega)} \right) \qquad (8)$$

$$\text{Bounded Morphism}$$

In other terms, we are faced here with an example of a 'functorially induced' homomorphism, from a coalgebraic *natural structure* of *natural kinds* (genus/species) into a *logical structure of predicate domains* (class/sub-class), as an example of modal *local truth,* applied to a theory of the ontological natural realism, in the framework of an evolutionary cosmology [23, 54], where it is nonsensical to use not indexed (absolute) modal operators and quantifiers, given that physical laws emergence depends on the universe evolution. In parenthesis, this gives also a solution to the otherwise unsolved problem, in Kripke's relational semantics, of the denotation of *natural kinds* (the denoted objects of common names, such as 'horses' or 'mammalians' in our example) and of the connected *causal theory of reference,* but on a 'naturalistic' basis, and not 'social' one, like in S. Kripke's [55], and I. Putnam's [56] theories.

To conclude, such a formal ontology of the natural realism of which I illustrated here only some basic principles and that I present systematically in a book actually in preparation [57] is able to give Post-Modern Age an ontology including both conscious (humans) and unconscious (computers) communication agents as the main actors of our Information Age, as I stressed in Section 1 of this chapter.

Therefore, for a final illustration between the modern 'Transcendental of Knowledge' and the post-modern 'Transcendental of Language', according to the 'complete linguistic turn' of Peirce semiotics, I introduce as an exemplification the comparison between Husserl's criticism, and Peirce's criticism to Schröder's first volume of his book on the 'algebra of logic' [58], which was the first historical proposal of a 'mathematical logic'. Peirce's contribution consists, indeed, in the proposal of an 'algebra of relations', correcting in a semiotic/semantic way the early formalistic proposal of an 'algebra of logic' by Ernst Schröder, without any necessary reference to a knowing, conscious subject [6], and consistent with his ontology of a 'semiotic naturalism' [9]. Edmund Husserl also shared this same criticism against Schröder formalism, almost in the same years, but independently from Peirce's semiotics. In fact, Husserl criticized Schröder formalistic approach to algebraic logic from the standpoint of the Transcendental of Knowledge [59], i.e., according to the subject-object intentional relationship, proper of phenomenological foundation of formal logic and mathematics [60].

In other terms, following Poinsot's early suggestion, updated to the actual situation, we can say that the proper of humans as conscious communication agents in our Information Age is the

abstract, because self-conscious knowledge of logical and mathematical truths, requiring for its formalization a second order set-theoretical semantics. This applies *globally* to an *infinite* universe of logical and mathematical *objects,* apart from any 'morphism' we can define on them, constituting the universal class *V* of a given formal system. *V,* therefore, defines the 'universe' of the objects with which a given axiomatic system is dealing with, i.e., the abstract objects 'formally existing' in the system. Now, 'necessary and sufficient condition' for the membership to *V* is that all its members satisfy *a self-identity relationship,*[9] a condition stated for the first time, in the history of Western thought, in Plato's Dialogue *Parmenides,* the dialogue in which Plato's metaphysics reaches its most consistent development.

The core of the modern transcendentalism, consists therefore, from Descartes and Kant on, Husserl included, in identifying 'self-identity' with 'self-evidence', so to justify in the usual logical jargon, the denotation of the members of *V* as 'objects' (as-to-a-subject) constituting the 'universe' of a given axiomatic system. Therefore, if we compare the definition of the *standard* notion of sets, just at the beginning of Fraenkel's *Abstract Set Theory* book and Husserl's parallel passage about the formal ontology of *independent objects* as 'parts of wholes' in his *Logical Investigations*, the common dependence on a Platonic ontology is a notion shared by both authors. For Fraenkel, indeed—who always affirmed the necessity for pure mathematicians of embracing a Platonic ontology [61]—both the 'intuition of objects' and 'collecting objects into an aggregate' are 'intellectual acts' [62, p. 6]. Let us compare the following two passages, respectively, of Husserl and of Fraenkel, for realizing this key point of the whole question of the modern transcendentalism in the foundations of logic and mathematics. Husserl:

> `Seen in their mutual interrelations, contents presented together on any`
> `occasion fall into two main classes: independent and non-independent con-`
> `tents. We have independent contents wherever the elements of a presenta-`
> `tional complex (complex of contents) by their very nature permit their`
> `separated presentation; we have dependent contents [i.e., "wholes"]`
> `wherever this is not the case`[63, p. 6]`.`

Fraenkel:

> `Definition of set. A set or aggregate is a collection of definite, dis-`
> `tinct objects of our intuition or of our intellect, to be conceived as a`
> `whole (unity)`[62]`.`

Where the two approaches diverge, it is about the different logical value to be attributed to *evidence.* For Husserl, such 'objects' of a logical system, and the relative 'axioms', as far as self-

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[9]'*V* is, by definition, the class of all those elements which are self-identical; i.e., since everything is self-identical, *V* is simply the class of all elements' [67, p. 144].

evident, are *apodictic* or 'absolute'. On the contrary, contemporary mathematics does not trust in 'evidence' because dependent on historical factors. In this way, modern mathematics, by embracing from B. Riemann on, the *axiomatic method,* can attribute only a *hypothetical* value to logical and mathematical truths, because 'relative' to the limited universe of objects defined through the axioms of a given theory. The role of *evidence* then remains only as to the *logical primitives,* on which the *meaning* of all the well-formed formulas—axioms, definitions and theorems, via the formation and deduction rules—ultimately depends in any formal system, as K. Gödel himself emphasized many times in his writings.

Today, however, this is not the full story. Besides the abstract way of humans of dealing with logical and mathematical truths, there exists also the way of the *unconscious communication agents* of dealing with *local truths.* They are based on a coalgebraic first-order semantics for Boolean algebras, for defining the representation space of these agents, and its continuous re-adaptation on the hidden correlations of data streams. As we anticipated in the Introduction, and now it is (I hope) more evident to us, this new generation of computational systems is not engaged in any 'imitation game' with our conscious *minds.* In the limit, indeed, they are imitating at last the *computational dynamics* of our pre-conscious *brains.* For this reason, they do not suffer the computational limits of second-order logics, and then of the 'Universal Turing Machine'. Therefore, they might support, integrate and only in this sense, substitute our minds —and the classical Turing-like computational architectures—in all these tasks, where they— our minds and the classical computers, as far as simple extensions of our minds—are destined inevitably to fail. These tasks are, indeed, ultimately reducible to only one: *reckoning with the complexity of reality,* in whichever natural, social, economic realm, without any unsustainable waste of time, and of computational resources. This is the challenge, but also the hope of our present time, as far as we become aware of it. We are humans, at last!

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What is 'Fashion' Really? The Promise of an Ecumenical Analytic for Fashion Studies and Beyond in a Globalized World

Anna-Mari Almila and David Inglis

Additional information is available at the end of the chapter

Abstract

This chapter addresses the increasingly complex question of the nature of fashion in a globalized world. While it is strikingly obvious that fashion is a global and globalized phenomenon, its specific character, and indeed geographical locations and origins, remain contested. Drawing inspiration from the Greek historian Polybius, and his ideas of an ecumenical analytical approach, to studying world-wide phenomena we discuss the current state of fashion studies in what we consider an ecumenical moment, holding many opportunities for the field. In order to lay out the roots of current debates, on such matters we review the history of fashion studies from the mid-19th century through to today, drawing attention to both the ontological assumptions and the epistemological and methodological dilemmas that have shaped the field, and that in some ways continue to do so today. We finish with some suggestions as to what the future may hold for the field if the ecumenical promise of global fashion research is truly realized.

Keywords: fashion, fashion studies, globalization, global, epistemology, ontology, history

1. Introduction: globalizing fashion and ecumenical promise

This chapter is concerned with the ontology, epistemology and methodology of studies of sartorial fashion. The field of fashion studies has grown dramatically since it began to be institutionalized as a distinctive academic field from the 1980s onwards. Since the early 2000s,

'globalization' has been a topic of discussion within fashion studies, especially as concerns the emergence of new centers of fashion outside of the 'Western' cultural sphere (e.g. [1, 2]). Reflection upon 'non-Western' aspects of globalizing phenomena mirrors the concern with such matters in the contemporary social sciences and humanities more generally. But as the field has grown and come to encompass ever more diverse empirical contexts for consideration and analysis, the expansion of the field's remit has not gone together with a sufficient consideration of the epistemological challenges that are created by globalization and increasingly complex forms of transnational connectivity. In other words, the empirical purview of the field has grown ever larger in terms of geographical coverage and consideration of new territories and terrains of fashion across the world, but the philosophical ramifications and problems engendered by such a situation have not yet been adequately thematized or thought through. In this chapter we seek to make a contribution to that project, by reflecting upon how the field can be more thoroughly intellectually globalized and rendered more genuinely epistemologically ecumenical, so as to be able more effectively to deal with the globalization of real world fashion phenomena.

We lay out what we take to be the promise of an 'ecumenical analytic' for future fashion studies. This is an epistemological framework which sets out how fashion studies can and should operate in a highly globalized world condition. What has not been remarked upon enough is that as fashion and clothing become ever more globalized in multiple ways, it is no longer good enough simply to apply theories and concepts which originated in the 'West' to contexts deemed to be 'non-Western'. Mainstream understandings of what fashion is and how it works originated in the metropoles of the 'West' and the global North, so simply deploying them to understand fashion phenomena in other locations is radically insufficient. So too is the analogous problem of unreflectively defining fashion in Eurocentric ways, such that operating with a narrow definition of what fashion is means that phenomena in 'non-Western' locations that could be construed as to do with fashion on a broader and more ecumenical understanding of that word, end up sometimes being dismissed as having nothing to do with fashion at al. Clearly all sorts of challenges to do with avoiding Eurocentric neo-colonial assumptions arise when globalization enters the picture.

It is no longer sufficient today just to call for more analysis of fashion globalization without considering the methodological and epistemological precepts that are necessary for analyzing such phenomena. This involves more than just debating different meanings and theories of globalization and applying them to particular empirical cases. Instead, much deeper reflection is needed on how globalization processes change not just fashion phenomena in and across the world, but also the field of fashion studies itself. The varied dynamics and processes that can be labeled under the generic heading of 'globalization' impact upon scholarly fields as much as they do on the objects that those fields are set up to study. Globalization processes create new problems of comprehension for a scholarly field such as fashion studies, at the same time as making possible new potentials in the analytic reach of the field. In other words, globalization makes some things more difficult and other things more possible or achievable for the first time. What we mean by an 'ecumenical analytic' for fashion studies involves reflection upon precisely these matters. This entails more than simply advocating a

particular theory of globalization or adjudicating between different theories. It is instead a meta-level reflection on how globalization processes simultaneously render both epistemological problems that need to be overcome *and* possible solutions to such problems.

The notion of an ecumenical analytic reflection upon scholarly fields is inspired by an apparently unlikely but actually highly pertinent source, namely the writings of the ancient Greek historian Polybius [3–5]. Polybius lived in the early period of the rise of what would later come to be called the Roman Empire, and he observed the massive and rapid expansion of Roman power across the Mediterranean world and further afield. He felt that the increasing interconnection of almost all parts of the known world in his time necessitated a radical re-thinking of the precepts of history writing and of what we today would call social scientific and humanities scholarship. It was not enough to describe using old categories and concepts the development of a densely interconnected world condition, where actions of human beings in one part of the whole could have all sorts of ramifications for people in all other places. Instead this new situation characterized by complex global connectivity had to be thematized and represented using new epistemological categories and novel methodological protocols. In essence, as a new ontological object—a highly connected world condition—came into existence, this required the forging of new concepts and methodological orientations in order to describe it, and to collect data about it. Polybius's meta-level reflection on how a changing world was necessitating changes to the scholarly field of history-writing identified both the problems, and possible solutions to those problems, that were being produced by what we today would call 'globalization'. He regarded the densely interconnected world situation both as the object for analysis *and* as the necessary condition for allowing that object itself to be investigated. For Polybius, the ecumenical analytic reflection revealed that a new form of writing and researching contemporary history is not only a *response* to the globalizing world condition, but also is *pragmatically made possible* by it. The key problem in understanding a world made up of places that previously were relatively disconnected from each other but now are highly connected in increasingly complicated ways, is that there is simply much more to be studied, both in terms of the number of locations and of the relations between them. The analyst cannot just rely on book-based sources, but must collect adequate empirical data on an ever greater range of locales [4]. Polybius was profoundly aware of the fact that it is impossible for the analyst 'to have seen with his [sic] own eyes all the different places in the world and observed their peculiar features', a situation especially compounded by the expansion of the number of places now involved in the globalized world condition (in Ref. [5]). However, he also argued that while such developments made life more difficult for the analyst, they also made his or her work tasks pragmatically *possible* in the first place. Previous analysts had made errors because they had been unable to access reliable data on far-flung lands. This problem had, however, been potentially resolved because 'the special characteristic of the present age [is that] since every sea and every land can be visited' by the analyst, more accurate knowledge than was hitherto available could be achieved (in Ref. [5]). To put it simply, globalization processes create a world condition that is challenging to study, but also provide the researcher with certain ways of dealing with those challenges. The analyst must master and generate information about many more locations and processes than hitherto, but the globalized world condition also furnishes them with opportunities to achieve precisely that.

This sort of meta-level reflection upon the relations between 'globalization', and the scholarly fields which study it, can be applied to the field of fashion studies today. Fashion studies wants to study the globalization of fashion, but to do so effectively, it has to reflect more on both the challenges and potential solutions thrown up for it by globalization processes themselves. In the analysis that follows, we argue that this is a potentially 'ecumenical moment' for fashion studies, but one which is characterized by unevenness and the need to overcome some of the challenges generated by globalization. New empirical data is being created all the time about diverse locations of fashion across the planet, so we know more than ever about what is happening in different places and researchers have greater access than before to those places (albeit in very uneven ways, depending on who they are, as we will see below). But there has not yet been a sufficient utilization of those data for the purposes of fully reconsidering what fashion is, how it works, and how it may operate in ways different from the manners in which mainstream understandings of fashion think it does. The latter have inherited a series of assumptions from earlier authors who problematically generalized the experiences of the metropolitan 'West' and the global North to all parts of the world. In this ecumenical moment, there is great potential for rethinking fashion, but the potential is undermined if research on fashion simply continues to reproduce the assumptions of the past. An ecumenical analytic approach draws attention to how these problems are engendered by globalization processes, and yet may be overcome if researchers make use more of the opportunities afforded to them by those processes.

To pursue such a reflection upon the nature of the fashion studies field today, we lay out a history of the field, so as to see how it has developed over time, how it still has built into it certain problematic assumptions inherited from the past, and how it contains an ecumenical promise at the present time. First, we consider the pre-history of the field, which encompasses a period running from the mid-19th century until the 1970s. During that time, there was a shift from talking about fashion in relation to 'civilization' in general, to understanding it in a more narrow way as something peculiarly 'Western' and 'modern'. This period was marked by various forms of Eurocentric and modern-centric bias and myopia. Second, we turn to examine how the field was institutionalized in the 1980s and 1990s, and how a newer focus on fashion as supposed product of 'modernity' was meant to solve the problem of connecting fashion to 'civilization', which by this time was regarded as an unacceptably imperialist term. Yet the Eurocentric biases of earlier analysis were retained unintentionally. Third, we trace the critiques made of the Eurocentrism of the field which began in the 1990s and were consolidated in the 2000s. While these critiques made various valuable interventions in the field, they did not manage to shape effectively the ontological question about what fashion essentially 'is', an issue which largely continued to be framed by assumptions inherited both from the pre-history and early history of the field. Essentially, the fashion studies field had started to be liberated from now untenable assumptions, but the full potential of that for rethinking stale and problematic definitions of 'fashion' had not yet been pursued. The chapter finishes by showing how that potential can now be more fully realized, and the epistemological groundings of the field recalibrated in a more productive direction that is more creatively attuned to the globalizing world conditions of today.

2. Before fashion studies: 'civilization' and 'modern' Europe

It is debatable when fashion studies can be said to have begun. According to some accounts, scholarly interest in fashion dates back to the time of the Renaissance [6]. But more generally, fashion studies as a field is often considered to have been established in the 1980s, with a number of landmark publications such as *Adorned in Dreams* and *The Empire of Fashion* [7, 8].[1] The new fashion studies of the time drew upon (and critiqued) a variety of previous research, among which some of the most important were classical sociological thinkers such as Thorstein Veblen and Georg Simmel [10, 11]. All the establishing works either explicitly or implicitly share some ideas. First, there is a recurring theme of 'civilization' or 'Western civilization', particularly in (cultural) historical approaches to fashion. Second, there is the idea of fashion's particular fit with 'modern society' or 'modernity'. And finally, there is an overwhelming consensus that fashion emerged exclusively in Europe. How did these ideas come to be so firmly established? To answer this, it is necessary to trace down these ideas further in the history of social sciences, for these are ideas deeply embedded in 'Western' understandings of history and the world.

The ideas of Simmel are well established within fashion studies [11], but he was not the first social theorist to write about fashion. Herbert Spencer touched upon the topic in his essay 'Manners and Fashion' already in the mid-19th century, and later discussed fashion in his famous *Principles of Sociology* [12, 13]. In the former, he links fashion with the individual person (as opposed to manners that connect an individual to others), and individual styles with democratic social order. Fashion for Spencer originates from the imitation of 'the great' or those in authority positions (he does not think authority automatically indicates greatness). This imitation has a dual motivation: the imitator seeks to express respect on the one hand, and to gain an equal footing on the other [13]. This, for Spencer, is not a 'modern' trait alone: 'Everywhere and always the tendency of the inferior to assert himself has been in antagonism with the restraints imposed on him: and a prevalent way of asserting himself has been to adopt costumes and appliances and customs like those of his superior' (in Ref. [14]). Yet in the earlier essay Spencer stresses that fashion is against political liberty as much as custom is, and that fashion is about stylistic monotony rather than freedom. Fashion is ambivalent in its promise of equality and its character of uniformity [12].

The theme of imitation, and the ambivalent and contradictory nature of fashion's motivations and expressions, recur in other classical sociological writings about fashion. Simmel considers fashion as an expression of both individuality and class belonging: it is about both imitation and differentiation [11]. For Gabriel Tarde, fashion is a particular form of imitation which is different from imitation achieved through tradition, and which emerges in historical eras when youth and urban centers set the tone of the times [15]. Ferdinand Tönnies considered the 'ever-new changes of dress and ornamentation' to be a consequence of 'the desire [for]

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[1]While this chapter is primarily concerned with how historical, Eurocentric accounts of fashion came to shape fashion studies, it must be acknowledged that cultural studies' importance for the development of fashion studies has also been significant (e.g. Ref. [9]).

distinction' among urban people, particularly those of high social standing [16]. The theme of urbanity is strongly communicated in many of these classical works, and is significant for later fashion studies too.

Thorstein Veblen, whose work has been of great importance for fashion studies over the years, makes a distinction between stability and change in dress: 'modern civilized apparel' contrasts with stable styles such as national folk costumes [10]. The terms 'civilization' or 'civilized' are used with apparent ease by these classical thinkers. For Simmel, fashion is part of the process by which 'civilized human kind has been laboring unceasingly to bring about [a break with the past]'. He considers 'civilized' people to be more open to change and 'foreignness', for '[t]he removal of insecurity with reference to all things new was accomplished by the progress of civilization' [11]. Not only is fashion's base motivation—the desire to differentiate—present in 'civilized' contexts, but for Simmel it is also the case that the removal of legal restrictions on how people may dress, characteristic of 'modern times', enhances and enables fashion processes. So the idea of 'modern' associated with fashion emerges by the end of 19th century and is often directly linked to 'civilization', like in the case of Tönnies: 'Trade and commerce, urban life, the growth of big cities, the power of money, capitalism, class differentiation, and the striving for middle-class status and education—all these are facets of the same development of civilization, which favors fashion and is injurious to custom' [16]. But differing opinions also occur in classical sociology. While Werner Sombart considered 'modern fashion' to be something that spreads rapidly 'across the entire modern civilized world', he also argues that not all fashion is linked to 'modern economic life' [17].

Social evolutionist ideas about civilization, which underlie many of these accounts, appear both more and less explicitly in many works about fashion. For Tarde, the chronological order in which 'semi-civilizations' turn into civilizations and mature civilizations is unavoidable, although it is not necessary for all civilizations to fully develop to maturity. Civilizations, for him, operate within their own limits through the means of habits and custom, but 'fashion' is what makes it possible for a particular civilization's principles to spread to other civilizations [15]. Tarde's ideas about fashion differ quite significantly from other definitions offered by other classical sociologists. One could say that for him fashion is visible in the macro-level processes through which 'Western' forms of, and trends in, sartorial fashion have spread to many other parts of the world, while most other scholars would consider the processes of sartorial change themselves as 'fashion'. Social evolutionist ideas derived from Spencer appear in later authors' writings, for example in Flügel's writings about clothing (although he also discusses evolution in clothing in more Darwinist terms too) [18, 19]. For him, fashion 'must be regarded as one of the most characteristic features of modern European civilization, since, in other civilizations, both of the past and of the present, fashion seems to have played a very much more modest rôle than with ourselves' [18]. It is worth stressing that by the time Flügel writes—the 1920s and 1930s—the terms 'modern', 'civilization', fashion and Europe had become firmly connected. This was not the case in earlier works such as Simmel's and Tarde's, whose discussion was more global, albeit shaped through readings of the anthropology of the time and, consequently, very Eurocentric in tenor. Later on, the broad, globally-informed visions of these thinkers came to be replaced by more localized and narrow approaches, often driven by disciplinary frames as these existed in particular national cultural and academic contexts.

A very early example of this within fashion studies is Alfred Kroeber's unique empirical approach to changes in fashion [20, 21]. While arguing that 'curves' of change can be detected in civilizations at different historical moments, he also sought to analyze 'measurable' changes in Western women's eveningwear. His methodological rationale is of some relevance to the discussion of the epistemological issues tackled in this chapter. He needed data that was accessible and covered long historical periods, and therefore he turned to French and North American fashion magazines of which his local library offered a reasonably comprehensive selection. In another early account, Quentin Bell, writing in the 1940s, drew heavily and explicitly upon Veblen's writings while paying attention to specific European fashion histories in his discussion of fashion. He concluded that 'Fashion as we know it in the West is not, and never was universal, it is a product of Europe and is of comparatively recent date' [22]. The capital F on 'Fashion' here is no mistake. For Bell, 'Fashion' and 'fashion' were two different matters: a distinction that survives in today's scholarship in the distinction between 'fashion system' and 'fashion' (where the former term usually refers to historically and geographically specific institutionalisations of the much broader phenomena of 'fashion', which the latter term refers to). He argues that seeking to find 'universal' reasons (as had allegedly been done by previous scholarship) for the emergence of 'fashion' ignores socio-economic, historically specific conditions that contributed to the birth of 'Fashion'. Here we witness again the shift from earlier, more general, more universal explanations, towards more localized accounts that were characteristic of trends in social scientific scholarship more broadly in the mid-20th century.

It is notable how already in these early studies, from the time before Spencer through to the period in which Bell was writing, the meaning and definition of 'fashion' is contested. According to Michael Carter, the meaning of the term before Spencer carried connotations to do with 'being in fashion', but with Spencer the concept came to be defined in more sociological terms, as a collective process governed by social laws [15]. Spencer's legacy in fashion studies is strong even when not directly referred to, or indeed when scholars are not aware of it. Similarly influential have been certain interpretations of Simmelian and Veblenian understandings of the 'civilized' and 'modern' characteristics of fashionable sartorial change, despite the ambiguity that is often evident in the original writings. The classical thinkers, despite their efforts to discuss fashion in universal terms, were faced with an important methodological issue. They were drawing upon anthropological studies of the time when seeking to understand dress and fashion phenomena outside of Europe [14]. But the usefulness of such anthropological research for understanding fashion can certainly be questioned. After all, these were studies often based on a relatively short time spent with a given community, and the studies were also typically filtered through certain pre-existing assumptions of socio-cultural stability [23, 24]. In European and North American contexts, with a plentiful supply of paintings, magazines and literary sources, it was probably easy to imagine that change only happened where it could be verified 'reliably' through such documents.

If in 1950s and 1960s interest in historical accounts of fashion was increasing [7, 25], the 1960s and 1970s saw a new wave of economic and sociological scholarly interest in the topic. In a 1963 special issue on fashion of the journal *Business History Review*, Fritz Redlich made a distinction between long-term and short-term change. Long-term change, which he calls '*Trach*',

is different from short-term '*Mode*' or 'fashion' [26]. This is relevant when discussing global expressions of sartorial change, for distinctions can be made between 'fashionable' and 'fashionless' change. So, for example, 'Chinese men of today wear a fashionless *Trach* [instead of fashion]' [26]. Familiar themes—civilization, modern society, geographical location—appear throughout this special issue. According to Dwight Robinson, 'fashion is not only a product of modern society; modern society is in an important sense a product of fashion'. On this view, 'since other civilizations—the Oriental, for example—did not invent the steam engine, the spinning jenny, et al., they never achieved a sufficiently materialistic-oriented culture to make possible the extravagance of fashion behavior' [27]. This is of course a deeply Eurocentric understanding of technical capacities and inventions. Yet in the special issue there are more interesting points raised too which show that fashion exists in many different locations, including perhaps unlikely ones. Robinson acknowledges fashion in female Hindu dress, Keiichrō Nakagava and Henry Rosovsky discuss fashions in Japan, and Goldman argues that fashions have emerged in the Soviet Union [27–29].

The 1960s was in fact rather an active time for fashion studies. A doctoral dissertation on the sociology of fashion is written, an edited book on dress, adornment and social order appears, and the well-known empirical studies of Roland Barthes and Herbert Blumer are published [30–33]. But while there were attempts to understand changes in dress outside the 'West' [34], the overwhelming assumption of the time was that fashion was a 'Western' phenomenon. Similar trends continued in to the 1970s. Pierre Bourdieu's analysis of haute couture was focused on Paris, as were Barthes' analysis of semiotic fashion systems and Blumer's discussion of fashion dynamics [32, 33, 35]. Yet a voice doubtful of the assumed European roots of fashion also emerged at that time. According to René König, even 'primitive civilizations' had changes in fashion, and '[e]specially among the so-called half-civilized [sic] peoples of India, Southeast Asia, the Far East, Central and South America we find an unusually rapid change of the fashions'. While remaining within evolutionist ideas of development and civilizations, König nevertheless allows for fashion phenomena outside of European 'civilization' [24].

The discussion so far has sought to demonstrate how certain ideas associated with fashion had been established by the time when 'fashion studies' as a field can be considered to have emerged in the 1980s. The methodological point here is that all these scholars were operating with limited access to empirical sources. They were also largely operating within Eurocentric ideas of history and social development, which had taken shape particularly during the 18th century and the first half of the 19th century. This narrative essentially claims a smooth development of Europe from Ancient Greece to Rome, through Medieval Christian times to the Renaissance, and further onwards to the Enlightenment, industrialization and the rise of the so-called modern world (or 'modernity'). Not only does this narrative reflect upon other parts of the world as those which did not fully 'develop' in the ways Europe and North America had, but it also ignores the vast intellectual and material influence that other parts of the world have had on Europe throughout several millennia [36]. Yet it would be surprising indeed if fashion scholars had been outside this widespread frame of Eurocentric thinking. Indeed, fashion studies has always followed trends current in the social sciences more generally, as will be obvious in what follows.

3. Establishing fashion studies: 'modernity' and the capitalist 'West'

The first powerful critique of the idea of fashion's association with (Western) 'civilization' came from Elizabeth Wilson [7]. For her, this notion implies an elitist stance, embedded in colonialism, imperialism and racism. König, following the famous arguments of Norbert Elias, had argued that ceremonial fashion's development in European courts was deeply grounded in the civilizing processes that were operative in courts and urban environments where elites were located [24, 37]. Yet when used as a political and ideological weapon, such associations between 'fashion' and alleged level of 'civilization' can be dangerous. Just as clothing (as opposed to perceived 'nakedness') has been seen as a necessary sign of full humanity, fashion's association with 'civilization' has been used as an evaluative, rhetorical tool of oppression by Euro-American elites over 'indigenous' Others [38, 39]. Dismissing such 'civilizational' claims, Wilson was more concerned with the idea of 'modernity' in relation to fashion. 'Modernity' (instead of 'modern society', 'industrial society' or 'capitalist society') emerged as a central concept in social theory in the late 1970s. The debates surrounding the concept questioned the ontology of the object studied by social scientists, namely the type of society within which Euro-Americans were alleged to live [40]. Wilson was the first scholar of fashion to seriously engage with the concept of modernity,[2] and her account remains influential today. She considered the new economic order of mercantile capitalism and the growth of urbanization that emerged in late Medieval Europe, to have led to an emergence of fashionable dress that was 'qualitatively new and different' from previous forms of dress [7]. On the one hand, her account stresses the importance of the capitalist economic order for fashion, and on the other, she stresses the dynamism and unprecedented desire for change as being fashion's strikingly 'modern' characteristics. Fashion is also, she argues, about individuality and identity, which 'become' a special kind of problem in "modernity". Fashion speaks a [of] tension between the crowd and the individual' [7]. Wilson is particularly critical of Veblen's account of fashion, which she considers dismissive, and ignorant of the special aesthetic logic characteristic of fashion. For her, fashion is 'an aesthetic medium for the expression of ideas, desires and beliefs circulating in society', and therefore cannot be reduced to economic forces and social hierarchies as was allegedly done by some classical thinkers [7]. Fashion, according to Wilson, is expressive of modernity and created through it. Modern mass production allows fashion's democratization (while exploiting the workforce engaged in its making).

Capitalism and democracy are two major points in the narrative of 'modernity' that emerged in the 1980s. Gilles Lipovetsky deals with similar kinds of questions in his account of fashion. For him, fashion properly emerges in 'modern society':

> *'Once we resituate fashion with the vast life span of societies … it becomes an exceptional, highly problematic institution, a sociohistorical reality characteristic of the West and of modernity itself. From this standpoint, fashion is less a sign of class ambition than a way out of the world of tradition. … the negation of the age-old power of the traditional past, the frenzied modern passion for novelty, the celebration of the social present' [8].*

[2]Blumer had used the term 'modernity' in his study of the Paris fashion world in the 1960s, but the meaning is not relatable to the later debates about the nature of modernity. For Blumer, modernity is associated with being modern, being timely, and being in fashion [33].

Lipovetsky argues that taking class distinction as a motivation of fashion, as was done by various classical thinkers, is mistaken, for it takes one function of fashion as its very basis. Instead, a historical analysis of fashion's emergence allows the socio-economic grounds for its emergence to be linked with processes of democratization and the development capitalism. As a sociologist, Lipovetsky reads these developments slightly differently from Wilson, a historian. An elementary part of modernizing a fashion system is its bureaucratization, which Lipovetsky argues to have happened with haute couture during the 19th century. Almost a decade later, Christopher Breward followed similar kinds of ideas, arguing that 'modernity' in fashion emerges in the 19th century, along with certain elements of modern capitalism, such as new kinds of advertising, new types of distribution systems, such as mail order, and increasingly powerful fashion magazines. Yet industrialization and technological development are equally crucial for new kinds of fashion at the time. Breward makes his points through the example of crinoline, which was made possible through a new, patented way of manipulating iron [25].

The critique of classical thinkers, especially as regards their focus on class-driven explanations for fashion, recurs throughout the 1980s and 1990s. Fred Davis agrees with this critique, and argues that instead of class, analytical focus should be on the multiple and ambivalent meanings embedded in fashion [41]. This does not mean ignoring elements of social stratification, but instead aims at analysis of different kinds of individual and group belongings, an approach characteristic of much scholarship of the time. While Davis connects fashion with modernity, his focus is on the social factors of 'modern society' rather than industrial, political or economic factors. For him, 'it is precisely the differentiated, socially stratified character of modern society that fuels the motor of fashion and serves as the backdrop against which its movements are enacted' [41]. Although less explicit about his focus on Europe as the locus of fashion, he nevertheless considers fashion as associated with 'Western civilization'. He also argues that the continuity of the fashion system in Europe is a sign of a certain level of cultural continuity, paradoxically expressed through processes of sartorial change.

As can be seen, a consensus about fashion's geographical and historical location was solidified during these decades. Typically this involved the ideas of fashion emerging around the mid-14th century, the significance of the emerging capitalist economic system for it, the influence of increasing democracy with in European states, and finally the ground-breaking transformation brought along with the industrial revolution. Fashion is taken to be both expressive of modernity, and created through its fundamental institutions. A point that is worth making here is that while 'modernity' is discussed as deeply linked to fashion, it is at the same time acknowledged that fashion in Europe emerged well before 'full modernity'. The problem with this set of ideas is expressed by Carter like this: 'too sharp an identification of fashion with modernity can lead to serious problems. … To simply equate "fashion" with modernity leaves us with no means of naming those regimes of vestimentary change that existed before the arrival of full modernity' [14]. A number of fashion history accounts argue that fashion is something geographically and historically extremely specific, while also taking the stance that numerous kinds of fashion systems have emerged throughout the centuries. Since no one would claim that 15th century court fashion and 1960s consumer fashion are the same thing, why this focus on 'modernity'? Even if it were to explain fashion in particular period(s) of

time, it would be lacking in its explanation of other eras. And even though 'modernity' can be described as a zeitgeist rather than as an historical era, as Wilson does in her later work, the term nevertheless usually refers to a historical period 'since the industrial and French revolutions' [42]. While 'modernity' offers some explanations of fashion phenomena when used carefully, it may also bring with it problems that are difficult to solve within its limited conceptual reach. The placing of the 'start' of fashion in the 14th century is also interesting here. This is the time when, according to some, 'European hegemony' over Asia and Africa starts to emerge [43]. Europe, previously peripheral in the existing world-system, starts to rise towards the core, dominant position that it then holds for several centuries. This rise is not peaceful, and large parts of it are based on ruthless military power, in a form sometimes called 'war capitalism' [44]. It would be possible to tell the story of European fashion in a very different light, acknowledging how its hegemonic position in the new world system is in many ways an illusion and ignores the significance of other parts of the world [36], of how this world order is laboriously created through forms of discourse and knowledge-making [45], and of how Europe's wealth, ultimately enabling the development of fashion, is largely based on exploitation of other parts of the world [44].

By the late 1990s, fashion studies had truly emerged as a field in its own right. Fashion had become an acceptable topic of academic enquiry, instead of a notorious 'f-word' [46]. This new field had also inherited certain assumptions and ideas, expressive of the social sciences of the time more generally. But, as we shall see below, a critique of precisely these assumptions had already also emerged. As the field became increasingly institutionalized, the number and variety of voices within it also grew. Crucial for the emergence of alternative voices was the establishment of platforms of knowledge production. While a number of clothing and fashion journals had emerged during the 1980s and 1990s—*Clothing and Textiles Research Journal* (1982), *The International Journal of Clothing Science and Technology* (1989), and *The Journal of Fashion Marketing and Management* (1996)—it was the launch of *Fashion Theory* in 1997 that proved that fashion studies had truly arrived on the academic scene in a consolidated form. This journal came to be the leader of the field, and indeed provided an opportunity for a more global form of scholarship to emerge. One of the reasons it was suitable for covering a wide range of sartorial matters is that it took a very loose definition of fashion as its guiding principle. Fashion was defined 'as the cultural construction of the embodied identity', a definition which allowed for a cover age of topics ranging 'from footbinding to fashion photography' [47]. This meant that it significantly widened the range of possible topics and locations to be included in the debates in the field.

4. Globalizing fashion studies: from lone voices to ecumenical opportunities

At the end of the 1980s, two foundational critiques of Euro centric ways of constructing the world were published in English: *Eurocentrism* by Samir Amin and *Before European Hegemony* by Janet Abu-Lughod [43, 48]. While these books have had practically no direct impact on fashion studies, the ideas expressed in them nevertheless found their way in subterranean ways

into 1990s debates about dress and fashion. Behind these debates lay a contradictory situation. On the one hand, the fields of 'fashion' and 'dress' research had come to be strictly separated in disciplinary terms, divided between cultural and fashion studies on the one hand, and anthropology and ethnography on the other. The major conceptual distinction between these areas was the presumed opposition of change in time versus variety in space. That is, fashion studies seemed to be concerned with rapid alterations in fashion trends, which quickly move across geographical areas, while anthropology seemed to be oriented towards more unchanging and geographically circumscribed and localised forms of clothing traditions. But at the same time, scholars were starting to question whether such binary conceptualizations were reasonable or indeed true. From the early 1990s onwards, there has been recurring critique of these divisions, of such binary ideas, and of Eurocentrism in fashion studies more generally. Moreover, the paradoxical result of the institutionalization of fashion studies in locations such as New York and London was that the channels created to communicate the field, most importantly the New York based *Fashion Theory* journal, actually enabled those voices that resisted the hegemony of Eurocentric fashion studies to be heard more frequently. In 2003, Buwar and Phatia edited a special issue for *Fashion Theory* on Orientalism and fashion, with a focus on African and Indian locations and colonial legacies. This was followed by special issues on Islamic fashion (2007), African (2009) and Australian (2009) fashions, black fashion (2010), peripheral European fashion cities (2011), Latin American fashion (2014) and Brazilian fashion (2016). The globality of fashion phenomena has been increasingly recognized in the 21st century in the pages of that journal.

The early critical voices of the Eurocentric hegemony in fashion studies emerged in 1993. Baizerman, Eicher and Cerny argued that many conceptually limiting problems in studies of dress were related to forms of elitism that assumed one-way influence in fashion: from elites to masses, and from 'the West' to elsewhere. In reality, they pointed out, these influences are always two-way processes [49]. They also pointed out that many ancient civilizations already showed signs of fashionable change in dress—a point much more elaborately and critically extended recently by Tortora [50]—and therefore the tendency to restrict fashion studies to certain historical periods and geographic locations has no sound basis in empirical reality. They also made a methodological point very relevant to the discussion here.

> *'The result of trying to access worldwide data on dress is usually limited. Many articles and books on dress published in English are printed in limited quantities and distributed poorly. Primary and secondary sources in non-European languages, including Chinese, Arabic, and Hindi, are challenging to access: few American or European costume historians have learned these languages, and English translations of such texts are rare. Furthermore, political animosities have erected barriers to an easy exchange of information and have limited our study of dress in politically sensitive areas of the world'* [49].

Empirical problems were recognized by others too. Aubrey Cannon argued that historical proof of the presence of fashion in particular times and places is often difficult to gain, for '[archaeological] evidence of prehistory is a much better record of the outcomes of style change than of the processes by which it occurs' [23]. According to her, empirical realities are often also filtered through ideas to do with the presumed conservatism of local peoples, and change in dress particularly in anthropological accounts is typically attributed to external

forces or unconscious, random choices rather than independent fashion processes. Based on her empirical case study of the North American fur trade, she argued that '[a]lthough the processes of fashion comparison, emulation and differentiation are more noticeably apparent in the rapid changes that characterize systems of industrial production, the same processes are observable or at least inferable in most cultures'. Therefore, a new, more inclusive definition of fashion was needed, which did not come with 'the requirement that [fashion] be the continuous process evident in recent Western industrial societies' [23].

Jennifer Craik recognized similar problems in the field of fashion studies. Her account is interesting because it comes from the cultural studies angle, unlike the two anthropologically-oriented accounts mentioned above. She suggested that by focusing on everyday fashion phenomena, both Eurocentric and elitist biases could be significantly reduced. Her important point is that fashion systems should not be 'confined to a particular economic or cultural set of arrangements'. She also recognized that 'while' not all clothing is fashion, all clothing systems have at least a distant relationship with fashion systems and stylistic conventions' [51]. These kinds of attempts to extend the definition of fashion in order to increase the geographical reach of the field did not take root at the time in fashion studies. What did change, however—partly influenced by cultural studies more generally—was the increasing inclusion of streetwear, everyday fashion phenomena and forms of dress resistance into the scope of fashion studies. But, again, the geographical extension of the topic suffered from methodological problems, as pointed out by Antonia Finnane over a decade later: 'If [these scholars, like Craik] failed to substantiate their arguments fully, it was in no small part because they were writing before a substantial body of empirical research on clothing cultures in non-Western societies was available' [52].

In the early 2000s, voices critiquing the state of fashion studies emerged with new force, and this time what they were arguing was embedded in empirical research material. Charlotte Jirousek argued that a mass fashion system emerged in the Ottoman Empire particularly during the 19th century. While this system drew upon European sources, it emerged due to local socio-economic changes that had been happening since the 17th century onwards, involving embourgeoisification in cities, increasing disposable income among the new middle classes, and increasing industrial production of clothing. Her more general point is that the emergence of mass fashion does not need to be connected to any specific economic system, including modern capitalism [53]. Leslie Rabine, focusing on African fashions both in Africa and in diasporas, argued that these historically-situated and often trans-national systems in fact challenge the binary conceptualization of 'traditional' and 'modern'. Instead, within such systems a garment can operate and be understood as 'traditional', 'modern' or 'authentic', depending on its location and its wearer. She argues that '[t]he African fashion systems... challenge not only the tradition/modern dichotomy but also the opposition between Western fashion and other forms of dress' [1].

Finnane argues that between the 16th and 19th centuries in China, there is plenty of evidence of fast, fashionable change in urban dress, as well as consciousness of change, another factor held important by many fashion scholars to be part of the definition of fashion. She brings up a terminological problem forced upon scholars by some definitions of fashion: 'when fashion

is defined very narrowly on the basis of particular empirical detail about "a particular sort of society", the possibility of any other clothing culture being described as "fashion" is by definition excluded… [T]his creates terminological problems in how to describe or analyze the phenomenon of short-term shifts in taste and consumption evident in non-Western urban societies that featured social mobility' [52]. According to Penelope Francks, economic growth and industrialization in Japan since the 18th century served to created fashionable change in kimonos, eventually resulting in the emergence of mass-market kimonos [54]. Similarly, Carlo Belfanti argues that fashions have emerged in China, India and Japan alike, which differed from the continuous, established fashion system in place in Europe, yet still were forms of fashion [55]. While many of these scholars agree that the ontology of fashion has not been properly re-evaluated by the majority of scholars in the field, their voices are increasingly being heard and demanding a response.

No one can deny fashion's globalized character today, but not everyone finds that this necessitates changes in definitions of fashion. Sandra Niessen points out that to recognize fashion's globalization while still believing that fashion is 'Western' is contradictory, yet 'alternative uses of the word "fashion" do not seem to have inspired a review of its accepted definition. New directions of theoretical inquiry that have been launched within the study of dress have not led to a critical retrospective of the field' [2]. Such a persistent tendency that she criticizes can be seen, for example, in Malcolm Barnard's approach to fashion a decade ago: he considers fashion a specific dress phenomenon 'found in Western modernity'. At the same time, for him fashion's emergence in society 'is a good test of whether that society is modern, or western' [56]. This argument has been accused of 'circularity' by Annelise Moors, who in her discussion of Islamic fashions is also critical of the exclusive location of fashion in 'the West' [57].

More recently, Joanne Entwistle has accused attempts to extend the reach of fashion studies as themselves guilty of Eurocentrism, claiming that 'to argue that fashion can be found everywhere and at other historical moments is Eurocentric; it is a view that imposes particular Western characteristics onto non-Western places, flattening out regional variations and differences and alternative systems of dress production, distribution and consumption. As such, it appears to see fashion as a trans-historic and trans-cultural phenomenon' [58]. It is indeed our contention here that fashion is trans-historic and transcultural, and *can* be found everywhere, but this does not mean that we argue it is actually found everywhere. What we argue for is an ecumenical and empirical approach that allows us to a) acknowledge fashion phenomena where they emerge, irrespective of our or anyone else's presumptions, and b) to reflect what kinds of refinements and changes the discovery and recognition of such phenomena demand in our understandings of fashion. This is not, as Entwistle would have it, a 'need to see fashion in all systems of dress' [58]. This is, instead, the scholarly stance that we should take empirical material seriously and allow it to shape our ontological and theoretical assumptions and conventions. Nor is this an attempt simply to dismiss most fashion scholarship as Eurocentric, a temptation against which Giorgio Riello and Peter McNeil warn. We agree with them when they say that the discussion should not be a shouting match where scholars exclaim '"fashion was there too!—you are all wrong!"'. Nor should non-European fashion be considered 'as a separate residual category' [59]. We instead wish to see a truly global field of study that takes

all parts of the world equally seriously in its attempts at understanding fashion phenomena and fashion's ontological nature.

It seems clear from the wealth of material available for fashion scholars today that we indeed live in an ecumenical moment for the field. Yet some problems persist. In many contexts it is difficult to acquire historical material and therefore, for example, 'much of the ethnographic work on African dress, because it has tended to operate in a normative present, has not provided a sustained, historical challenge to [the] Eurocentric vision' [60]. A more hidden problem, yet one that many scholars are increasingly aware of, is that of geographical mobility as it is either allowed, enabled, denied, or enforced upon individuals. Just as Polybius was privileged over most others alive at the time in his freedom of movement in the early Roman Empire [61], some scholars today are significantly privileged over others in their passport power, visa access, institutional affiliation, access to books and journals, travel funding and research project funding. A further limiting factor is language. English has been so established as the lingua franca of fashion studies that lacking fluency in the language can seriously hinder the distribution of one's research findings. To tackle precisely this problem, *The International Journal of Fashion Studies* launched in 2014. Based in the very core of the global fashion world (the editors are affiliated with universities in Milan and London), it nevertheless seeks to tackle especially language-driven imbalances inherent in fashion studies, a problem particularly pressing in an increasingly globalized era such as ours [62].

5. Conclusion

This chapter has considered the ecumenical promise of and for fashion studies that exists at the present time. This promise is not just a possibility but a necessity if fashion studies is both to understand the densely interconnected world that it must comprehend, and to take effective advantage of the conditions furnished for scholars in the field by that world condition. Just as Polybius in the period of the early Roman Empire reflected upon the ontological, epistemological and methodological possibilities for scholarship in his age, so too must fashion scholars reflect upon such matters, both to solve the problems generated by globalization and to take advantage of the solutions that globalization processes also create. The inspiration afforded by a Polybian ecumenical reflection rests around the need today to think in a broader sense than is often currently the case in fashion studies, and to avoid the dangers of an unreflective acceptance of different kinds of narrowness, ranging from restricting the definition of 'fashion' purely to modern and 'Western' social conditions, and sequestering analysis of fashion in different parts of the world into the silos of specialist sub-fields. An ecumenical reflection like the one pursued here seeks to make visible how concepts emerge and are sustained in particular scholarly fields, and can get reproduced even through ostensible critiques of them.

So far, the critique of allegedly Eurocentric biases in fashion studies has been largely connected to empirical research outside Euro-America. This has often left the core of fashion studies untouched, as these fields have been labelled as 'African fashion', 'Asian fashion',

'Islamic fashion' and so on, reducing their apparent capacity to inform rethinking of what fashion 'is'. At its worst, such a scenario leads to the inability to see affinities and resemblances between different contexts of fashion. A properly ecumenical approach to objects of analysis called 'Islamic fashion', 'Chinese fashion', and so on, recognizes that a balancing act is necessary—that in the past fashion operated in such contexts in ways that are not entirely like the modern West and the contemporary globalized systems of fashion, but yet bear certain resemblances to the latter. An ecumenical approach allows for careful comparisons to be made between different fashion systems that have existed in different points across time and space—it does not deny the possibility of making such comparisons, as happens when 'fashion' is said to be wholly modern and Western. An ecumenical approach strongly resists seeing 'Islamic fashion', 'Chinese fashion', and so on as subfields which simply exist mostly in their own right. They should instead be seen as particular exercises in a much broader comparative framework, with studies from one particular area being used to inform understandings of all other areas. This is essentially the point of Max Weber's historical sociology, where different culture regions are studied precisely to throw light on each other, understanding their commonalities and differences simultaneously [63]. This was also the strategy of the recently-deceased historical anthropologist Jack Goody, whose Weber-inspired framework involved using massive amounts of data to compare and contrast the civilizational complexes of East Asia and Africa [64]. A similar orientation can be found in the work of the late S.N. Eisenstadt, another Weber-inspired scholar, who sought to compare and contrast phenomena in different civilizational entities over thousands of years [65].

All of these scholars arguably shared the Polybian imaginary of looking at phenomena in as ecumenical manner as possible, and they provide certain suggestive ways of making fashion studies more genuinely ecumenical. But where we can go beyond these scholars, again in the spirit of Polybius, is by going beyond merely comparing different fashion systems from across time and space, and showing how these systems may have impacted upon each other, with fashion phenomena moving across civilizational and cultural boundaries, both at particular points in the past and today. Fashion studies needs to bring to its analysis considerations of planetary connectivity that are obviously happening now and also happened, sometimes in less obvious ways, in the past [66]. Too few studies are informed by such an ecumenical orientation, and we suggest that fashion studies needs to be developed much further in this direction. Just as Polybius did, all case study material drawn from specific locations must be animated by and deployed for the purposes of a broader and genuinely ecumenical analytical framework. Too many otherwise excellent studies remain narrow in their focus, even when they deal with transnational connections which are involved in the creation and operation of fashion within the geographical and cultural areas they study. They lack broader narratives that consider three things—first, both the explicit and implicit aspects of border-crossing as regards the fashion phenomena under consideration; second, consideration of how fashion in that place compares with the workings of fashion at other times and places; third, and most profoundly, reflection upon how the empirical data, located within an ecumenical frame and narration, informs the ongoing questioning at the definitional level of what fashion 'is' and how it works. Every particular study should contribute to the ongoing reconstruction of the definition of fashion, so that better, more empirically and historically adequate definitions can constantly be created and then critiqued in the light of new studies that are constantly emerging. Ecumenically-driven fashion

studies requires particular kinds of scholars—those that know their 'own' specific area of investigation inside out, while being able to locate those much more broadly, in terms of comparisons and considerations of empirical modes of interconnectivity between different places and social groups. Such an approach requires scholars to familiarize themselves with a vast amount of literature and data from parts of the world they are not complete experts in, for the purposes of better situating their own studies and of rendering more effective their contributions to the grand questions about what fashion is and how it works. This is what the capacious thinkers of the 19th century were able to do, at least in part, reading ethnographic materials and seeking to synthesize their findings into broader comparative frameworks. Empirical studies today are incomparably better than the flawed ethnographies of the 19th century, not least because scholars are nowadays much less reliant on the biased accounts of others, and in an interconnected world may be able to travel to observe particular phenomena for themselves, the very potential for improving scholarship anticipated by Polybius two millennia ago. The promise of a genuinely ecumenical approach to fashion may still be beset by all sorts of challenges, but it is more within our collective grasp than ever before.

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Epistemology and the Transformation of Knowledge in the Global Age: God and the Epistemology of Mathematics

Peter Zamarovský

Additional information is available at the end of the chapter

Abstract

Mathematics, as a scientific discipline, developed from the rather humble beginnings of practical counting and measurements. The Pythagoreans shifted this discipline to the ideal, intelligible world—the "Pythagorean paradise"—where it remains to this day. However, there have been doubts as to whether some of the more peculiar mathematical concepts (irrational numbers, zero, negative numbers, infinity…) also belong to this "Paradise". Within Theo-Platonism of the fourth century, the Christian God legitimised the concept of infinity. God then acted as guarantor for the existence of infinity even in the nineteenth and twentieth centuries. Later, however, God was played down with explicit references to Him having been eliminated. He remained hidden, as it were, in the "supernatural axioms" of set theory. Attempts to "excommunicate" Him consistently from the foundation of mathematics had only a negligible impact on the mathematics itself. Was it due to the fact that those formal foundations of mathematics (the set theory) are not the true foundations, with the actual basis being in mathematical practice?

Keywords: God, epistemology of mathematics, infinity, set theories, alternative set theories

1. The origins of mathematics

1.1. Pythagoreanism and mathematical Platonism

Even prehistoric hunters numbered the game that they caught, as well as their cattle, wives, and children. Later, people measured their fields, they measured and counted the pieces of wood and stones when they built their houses and temples and manufactured things of

daily use. When currency was invented, calculations were necessary for how much, for what remains and for how much is owed.

This primitive pre-mathematics—the useful, practical tool—is the basis for "scientific" mathematics, as we understand it today. According to Proclus, it was Pythagoras who stripped mathematics from the servant position in crafts and trade and elevated it to the "liberal arts". Mathematics shifted to the ideal, intelligible world, the world visible only to our inner sight, the world where everything is absolutely accurate. Mathematics has remained in this "Pythagorean paradise" to this day. More precisely, it stands between our daily, temporal, physical world (which supplies it with practical problems) and the higher, eternal, metaphysical world—the "Pythagorean paradise". In the original Pythagorean view, this "higher" world also has a "supernatural nature". Numbers not only expressed quantities but also bore deeper, metaphysical meaning. There is, however, a close mutual interaction between these two realms: the "higher" metaphysical world helps mathematics solve practical problems, and the physical world serves as a window through which flesh sparks from the "higher" world. This higher world, however, also carries problems of its own, to be discussed in a later section.

It was Plato who expanded and absolutised this Pythagorean paradise and created the realm of forms-ideas. This realm concerns not only mathematics but also spans above the entire mundane world. This conception of mathematics is called mathematical Platonism, though it should preferably be called Pythagoreanism—but history isn't usually fair. (Especially astounding in this connection is the fact that, in Plato's system, mathematical forms had a slightly lower degree of reality than other forms. See Plato's Republic.)

It bears mentioning that many candidates for entry to that mathematical paradise were and still are of suspicious nature and their adoption is regarded with hesitation. Allow them inside, or rather not? During the time of the Pythagoreans, the most provocative question concerned irrational numbers. Such queer numbers were called ALOGION—"illogical"—or "ALOGION KAI ANEIDON"—"inexpressible and unthinkable". More precisely, the Pythagoreans refused to even consider such peculiarities as numbers; they refused to attribute existence to them and didn't allow them into their "mathematical paradise". An even bigger problem presented itself with APEIRON, that is, infinity. The concept of infinity holds a place in ancient history but, as with all other old concepts, that of infinity was still very vague. The Pythagoreans then tried to clarify the meaning of APEIRON and integrate it into their mathematics. Their attempt, however, was unsuccessful. Infinity was also "ALOGION KAI ANEIDON", that is, in contradiction to reason and non-restrictive.

Since rationality verbally and consequently also conceptually coincided with the numerical ratio—with the existence of rational numbers (in mathematics it still coincides, at least on a verbal level), the Pythagoreans concluded that rational numbers can express all quantities. A rational number can truly approximate any value with arbitrarily high accuracy. A physicist or an engineer would manage them easily. However, this "reasonable assumption" led Pythagoreans to the dispute, which was not only perceived as the first mathematics crisis but mainly as a crisis of reason-LOGOS.

Admission of such suspect concepts like infinity or irrational numbers would subvert their mathematical paradise. Since everything is a number and a defining limit, our world would

have collapsed along with the fall of the mathematical world—at least according to the Pythagoreans—however, this thesis is repeated even by some mathematicians today [1].

The issues of irrational numbers and infinity have the same denominator, as irrational numbers contain an "inner infinity". Their writing as a fraction (LOGOS) would have to consist of an infinite numerator as well as denominator—if that were possible. Even their decimal notation would be infinite—if that were possible… (The Pythagoreans were obviously unaware of that at the time.)

Humans can't discover a new ocean until they have the courage to lose sight of the shore.

- Andre Gide

According to the legend, the Pythagoreans tried to keep the existence of incommensurability (irrational numbers) a secret. It contradicted their basic idea that the world is rationally tangible. It is also said that the life of Hippasus, the (alleged) discoverer of incommensurability, ended in the depths of the sea. Apparently, he was drowned by the gods because he revealed the Pythagorean secret. Perhaps he was drowned by the Pythagoreans themselves. The story is even alive today as it is witnessed by another variant of the legend, authored by the contemporary mathematician, Rudy Rucker [2]. He suggests that Pythagoras himself was behind the death of Hippasus. Rucker, however, neglected to mention that Hippasus lived a hundred years after Pythagoras. Be that as it may, the story is more important than the facts insomuch as "poetry is more philosophical than history", as stated by Aristotle [3]. The aforementioned legends can be understood symbolically: poor Hippasus drowned in the very APEIRON that is hidden in the concept of irrational numbers. Just as the body can drown in the boundless vastness of the ocean, the soul can be drowned in the immense APEIRON. APEIRON is a metaphor for the ocean, and the ocean is a metaphor for APEIRON-infinity.[1]

1.2. Actual and potential infinity

According to Aristotle view, we should consider two types of infinity: the actual one which is present here and now, and the potential one which is present only in a possibility. In his Physics [4], he says that infinity could be understood similarly as a finite number, that is, the quantity of some units or some size. This would correspond to actual infinity. Although in nature, we don't encounter such limitless quantities and we apparently don't need it in mathematics either. For example, we can imagine dividing a segment into an infinite number of parts, but no one can carry out such a task. Therefore, it is necessary to reject the existence of actual infinity. In essence, only the potential infinity (DYNAMIKOI) remains. (For details see Refs. [5, 6].)

The concepts of actuality and potentiality (ENTELECHEIA and DYNAMIS) were introduced by Aristotle already in his Metaphysics [5, 7]. He illustrated them in the example of marble or bronze. These materials are a statue in their potentiality–possibility. All that is necessary is to cut away the superfluous stone, cast the metal in the mould. The possibility will be fulfilled, realised. However, in the case of infinity, Aristotle's analogy of the statue is clearly lacking. Unlike the "actual statue" in which the "potential statue" (i.e. a piece of stone) can be

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[1]In 1991, a minor planet was named after Hippasus (1991 XG1, cat. no. 17492). So now Hippasus floats in the infinite ocean of cosmic space.

remodelled, potential infinity can't be "remodelled"–as actual infinity does not exist! Aristotle himself was aware of this issue:

> *We must not take "potentially" here in the same way as that in which, if it is possible for this to be a statue, it actually will be a statue, and suppose that there is an infinite which will be in actual operation.*

> *Aristotle, Physics III. 6. 20* [4]

Despite these problems, Aristotle accepted the existence of potential infinity as did all other ancient mathematicians. (Actual infinity, as we will see, was not afforded the same acceptance for quite a long time.) For example, Aristotle considered the number of points on a line as potentially infinite. In Aristotle's view, a line doesn't "consist" of an infinite number of points nor can it be divided into an infinite number of points. (This view was already pointed out by Zeno of Elea in his APORIA on a bisection of a line.) We can, however, create points on the line without limitation–by cutting it in half over and over, for example. We will always reach only a finite number of points, in this case. Aristotle's opinion actually defines what the concept of existence means in the case of points on a line (as well as other geometric shapes, of course). In this manner, Aristotle introduced the category of potentiality into mathematics.

However, using the concept of "potentiality" regarding infinity is problematic. Potential infinity isn't something that can be achieved or something that we can approach. "Approaching infinity" is just receding from finite limits–from certain finite numbers and values. Potential infinity can't be defined by actual infinity as it is only the negation of the finite. It is not defined positively nor is it "something" I can "have in front of me" in some sense; it is not an object. Potential infinity is a mere designation of a process which is altogether impossible to be finished in principle. Its reality is, in essence, only "borrowed".

> *In fact, potential infinity has only a borrowed reality as it still refers to actual infinity, thanks to which it is only possible.*

> *Georg Cantor* [8]

So-called potential infinity is but an ongoing process of enlargement,[2] a movement in a general sense. Although movement isn't actual nor potential, according to Aristotle! Wouldn't it be, therefore, more accurate to speak of processual infinity?

1.3. God approaches the world of mathematics

As we have seen, the Pythagorean God (perhaps there was only one God in the Pythagorean religion) protected people against paradoxes and confusions. The role of the Christian God was different, however. Although not a mathematician, it was St. Augustine who first summoned God to the realm of mathematics. Augustine attempted to combine Platonism and Christian theology on the philosophical plane. In his "Theo-Platonism", he placed Plato's realm of forms (ideas) in the mind of God. The existence of infinity Augustine justified on the grounds of God's omniscience. Since God is all-knowing, He must know all numbers; hence, He must also be cognizant of infinity [9]. In this manner of thinking, actual infinity exists–at

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[2]In the case of infinite small (infinitesimal), it is infinite reduction.

the very least in the mind of God. Variations of this theological "proof of infinity" have survived to the present day, though this "proof" is open to question even in terms of theology:

1. It was Thomas Aquinas who, in his attempts to rationalize theology, demonstrated that not even God can know concepts that are intrinsically contradictory, that is, nonsense. So if actual infinity were a dubious concept, not even God could help it [10].

2. The second objection: If (actual) infinity exists in front of God's eyes, does it mean it should exist also for us mortals? How does this relate to the story of the forbidden fruit of knowledge?

3. And perhaps the most serious objection: is it appropriate to suppose mathematics could be dependent on theological arguments?

1.4. Arriaga, God and actual infinity

The concept of infinity was addressed by many philosophers and mathematicians. Most of them surrendered before it due to its paradoxical and contradictory nature. (Descartes, Galileo…)

But what is meant by "paradoxical nature"? This is simply a contradiction to our presentiment of how things should be. It is a contradiction to our subconscious philosophy of mathematics and in conflict with our prejudices. But what about "real, that is, inner contradiction"? This means mutual conflict of accepted assumptions. However, in the case that we have two contradictory assumptions, does it mean therefore that just the assumption of the existence of infinity should be avoided?

One of those who were not afraid of accepting infinity was Spanish Jesuit Rodrigo de Arriaga (1592–1667).[3] He worked in the first half of the seventeenth century as a professor in Clementinum College in Prague.[4] (As a curiosity, it bears mentioning that Arriaga illustrated the existence of actual infinity by way of the number of angels.) Arriaga accepted the existence of actual infinity and divided it into five types: four secular (infinity in number, extension, intensity and perfection-quality) and one divine which is related to God only [11, 12]. He formulated many interesting and farsighted approaches to infinity; however, he did not create a consistent mathematical theory of infinity.

2. The birth of set theory

2.1. Bernard Bolzano, the grandfather of set theory

One of the most interesting thinkers to undertake the problem of infinity was Bohemian scholar Bernard Bolzano (1781–1848).

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[3]Arriaga tried to reconcile the atomist and Aristotelian approaches [11, 12].
[4]Clementinum College later joined with Charles University, the oldest University west of the Alps.

Bolzano studied at Clementinum College, where the spirit of Rodrigo de Arriaga lived on. Upon completion of his studies of philosophy and mathematics, he was still concerned with matters of theology. He was a lengthy hesitation. He was influenced by the ideas of the Enlightenment and approached all of the supernatural with scepticism. Wasn't it all only myth and delusion? Wasn't it in contradiction with history? Eventually, Bolzano acquiesced to the ethos of the moral and practical implications of religion–that faith in God brings good to people and he aimed to take part in the dissemination of good help. On 7th April, 1805, he was ordained a priest, and ten days later, he graduated as a doctor of philosophy. Bolzano preached at the Church of the Holy Saviour (a part of Clementinum College) and taught at the newly established department of religious studies. His position was rather complicated, however, as there was a strong anticlerical sentiment among the students, and Bolzano was booed. Eventually, Bolzano gained control of the situation and became a popular teacher. Nevertheless, he soon faced resistance from the opposite side. Bolzano's idiosyncratic views and his approach to religion were met with contempt at the Vienna suzerain. A professor of religious science paid by the Austrian State was thoroughly expected to teach only what he had been instructed. He should not independently invent, even if it were to be new evidence of God's existence. This trend of inventing new theory originated solely, according to the commission, in philosophers' vain delusions of grandeur.[5] The affair led to a ban on Bolzano's teaching and publishing. Subpoenas were delivered to Bolzano on Christmas Day, 1819 [13–15].

Bolzano wrote a number of treatises in the field of philosophy, sociology, mathematics and logic. In his Wissenschaftslehre (Theory of Science), Bolzano defined the concept of the set (die Menge), a concept that would become central to future mathematics [16]. Bolzano's final work was Paradoxes of Infinity (published 1851, three years after the author's death) [17]. On the basis of theological considerations, he acknowledged actual infinity and formulated some original approaches to it.

Bolzano justified the existence of infinity roughly as follows: It is certain that there is at least one true sentence, one truth. Therefore, it is also true that there is one truth. Furthermore, it is true that there is truth concerning the existence of truth etc. An omniscient God must know all these truths; therefore, He must also know infinity. (The question remains: why doesn't Bolzano say that God knows all the numbers? It could be proposed that He knows them all, but not necessarily. He must, however, know all truths, etc.) The argument is perplexing, especially when we consider how sceptical Bolzano had been regarding the supernatural. Perhaps he concluded that belief in God also brings about "mathematical good"?

In Bolzano's approach, there existed many sizes of infinity: the infinity of points on a longer line is greater than that of the shorter line; the infinite number of points in a square is bigger by order than the number of points on a line, etc. He failed, however, to give complete mathematical form to his approach (the possibility of which is still uncertain). And he also did not realise the crucial role of infinity in mathematics.

Bolzano had the misfortune of working in isolation, without contact with mathematical society. Subsequently, his provocative ideas nearly fell into oblivion. It took more than a hundred

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[5]Many of Bolzano's attitudes are reminiscent of the opinions of Hans Küng.

years for new approaches to set theory to emerge in the middle of the twentieth century, whereby some of Bolzano's notions found new life (or were, perhaps, reinvented).

2.2. Cantor and his set theory

There is no doubt that the genuine father of the set theory was the German mathematician Georg Cantor (1842–1918). His theory of sets constituted a revolution in mathematics. To this day, most mathematicians regard his set theory as the undisputed "gospel" truth, the image of objective reality.

Cantor's criterion of equivalence of sets is one-to-one correspondence (bijection). This criterion represents the basic difference from Bolzano's approach. (According to Bolzano, a one-to-one correspondence exists even between infinite sets of various sizes. This peculiarity represented one of Bolzano's paradoxes of infinity.)

Cantor also assumed that there are different sizes of infinite sets but he defined their size differently than Bolzano. (Different sizes of infinity in Bolzano's concept are equally large in Cantor's theory.) He marked the size of infinities with the so-called cardinal numbers, cardinalities or briefly, cardinals. The cardinal number of the "smallest infinity" was marked as aleph-zero. This infinity denotes the quantity of natural numbers. According to Cantor, it also corresponds to the quantity of rational numbers. (Cantor found a one-to-one correspondence between the sets of natural and rational numbers.) On the other hand, the size of the set of real numbers is greater, the cardinality of real numbers being aleph one. Cantor proved that the one-to-one correspondence between real and natural numbers didn't exist. Soon, Cantor discovered how to construct larger and larger infinite sets. In Cantor's view, there were an infinite number of cardinalities. The infinities grow ever skyward to an infinite infinity–the Absolute. This greatest infinity is impossible to capture by human means; by mathematics, this infinity belongs only to God [18, 19].

The fundamentals of set theory were created in their entirety in one mind–the mind of Georg Cantor. Cantor's original intention was, however, not so ambitious, i.e. the study of the so-called fundamental series.[6] He was surprised by the world he had opened (invented or discovered?) to mathematicians–the world which David Hilbert called "Cantor's mathematical paradise".

To understand the important role religion played in the development of set theory, let's stop for a moment to examine Cantor's life course. Born in St. Petersburg, he with his parents moved in 1856 to Germany. His mother was a Catholic and his father a Lutheran. Deep religious faith was reflected in all of Cantor's life as well as in his work. Georg was gifted not only in mathematics but also in music and art and went to study mathematics in Zurich. After his father's death, he moved to Berlin and then to Göttingen to study. In 1867, he defended his doctorate, and at 34 years of age, he became a full professor of mathematics at the University of Halle.

However, Cantor's life also had a downside. Shortly after his 39th birthday, his mental illness developed. He never freed himself of the manic and depressive attacks and was repeatedly hospitalized at the neurology clinic. The trigger for the first seizure was a conflict with his former teacher, Leopold Kronecker, who considered Cantor's infinities insane and a source

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[6]These series are also called the Cauchy or Bolzano-Cauchy series.

of many contradictions. Cantor couldn't find understanding even from Henri Poincaré who, at first, enthusiastically accepted his theory. He turned away from Cantor's work, however, when contradictions appeared. Regarding Cantor's theory, Poincaré said that it represented a "lethal infection for mathematics". Even Cantor's close friend Mittag-Leffler discouraged him from publishing the results, stating that they wouldn't be understood as they were too ahead of their time. Cantor surmised that his focus on mathematics was too narrow and didn't lead to a proper valuation. He began looking for new interests that would help him overcome his deep depression. In 1899, he was again in crisis. Within a short period, his mother, brother and his talented, thirteen-year-old only son all died. Cantor reassessed his life and regretted that he hadn't dedicated himself to music instead of mathematics. He wished to leave teaching and requested the job of librarian. He attached a curious remark to his application: he stated that he had some important findings regarding the early English kings, knowledge that would certainly shock the British Government. If his request stood without response, he would join the service of Czar Nicholas II as a native Russian. After further hospitalization in 1905, he announced that he received the inspiration from above to re-study the Bible without prejudices and with open eyes. "Enlightened from above", he wrote down the interesting moments from the history of Christianity. His final admittance to the clinic began in May 1917. He didn't live to be released from the clinic or to see the end of the war. His earthly journey ended on the feast of the Epiphany, 6th January, 1918.

Cantor had many opponents among mathematicians. Conversely, he found kinship among Catholic theologians. God's mind is infinite, and therefore, it must also contain infinite sets. Actually, St. Augustine argued similarly, and, in the nineteenth century, Bolzano, Dedekind, and neo-Thomist, Constantin Gutberlet also formulated similar "proofs of infinity".[7] Cantor himself believed that the existence of infinities is warranted by God–after all, it wouldn't be worthy of the Almighty to create only finite sets. This calls to mind the "heretical argument" of Giordano Bruno, who used nearly the same words to justify the infinity of the universe! In the case of Cantor, however, theologians also started to worry: Will Cantor's theory perhaps lead to the identification of God with the infinite? What would be the consequences? Fortunately, it was no longer the sixteenth century and heretics didn't end in flames. Cantor's eloquence dispelled these doubts. Prominent theologian Johannes Baptiste Cardinal Franzelin commented that the concept of transfinite infinity–as he understood it–didn't hold any danger for religious truths. Ironically, set theory was then recognized sooner by theologians than by mathematicians.

> *The wisdom that we teach comes from God, full of secrets. Years ago, God predestined it for our glory.*
>
> *St. Paul, First Corinthians 2.7*

Paradoxically, Cantor himself couldn't explain his success rationally. He stated that the theory of transfinite numbers was told to him by a "powerful energy"–who other than God? He claimed that he was merely a messenger chosen to proclaim that truth to humanity. How these events mirror those in the life of St. Augustine! He also couldn't explain the reason for his sudden life turn–leaving a debauched life for an inclination to Christianity–and so also attributed it to a divine intervention! Cantor gradually sought God's intervention in his entire

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[7]For the climate of that time, a return of the church to the teachings of Thomas Aquinas was characteristic. Neo-Thomism tried to reconcile theology with an exact science and philosophy.

life. Eventually, he began to understand his set theory as a "theory of everything", as it concerned not only mathematics but also the world of the Divine and physics.

Cantor constantly sought a career at the prestigious University of Göttingen or Berlin. Backroom scheming by his enemies, however, obstructed his plans. Cantor fell under the impression that he was being persecuted, that someone wanted to silence him because he had revealed uncomfortable secrets. In the end, he came to the conclusion that God was the reason his career ambitions weren't fulfilled:

> *Now, however, I thank the Almighty and most good God that He still denied the fulfilment of my desire to obtain a better place at the University of Berlin or Göttingen, because this way I was forced with deeper insight into theology to serve Him and His Catholic Church better than I would have been able to with my exclusive passion for mathematics.*

> *Georg Cantor, letter from 1894* [20]

Cantor died in January 1918. His arch-rival Leopold Kronecker (+1891) was also dead and so were other of Cantor's opponents. The dispute of finitism and transfinitism was slowly fading. The onset generation of mathematicians accepted and further developed Cantor's mathematical results.[8] Together with these results, they also subconsciously accepted God hidden in Cantor's presumptions.

Contradictions soon emerged in Cantor's original (so-called naïve) theory, which obliged mathematicians to underpin it by systems of axioms. Problematical sets were excluded. However, it soon became apparent that the complete axiomatisation of the theory was not possible (as was demonstrated by Kurt Gödel). Even the "corrected" axiomatic theories gave rise to a number of paradoxes, that is, contradictions with an intuitive opinion, with our "unconscious philosophy". They may be viewed positively as remarkable discoveries from the higher, "divine world of mathematics", or negatively as a sign of the theory's detachment from reality.

However, after some initial hesitation, the majority of mathematicians accepted Cantor's theory. "Cantor's paradise" represented a fragment of a much spacious paradise which had been opened by ancient Pythagoreans. To this day, most mathematicians do not hesitate to recognize the verity of Cantor's approach, and their vision is to base the whole of mathematics on the set theory. That endeavour culminated in the works published under the name of Nicolas Bourbaki, which surfaced during the period between the thirties and the eighties of the twentieth century.

3. Mathematics returns to the earthly world

3.1. First attempts

Cantor's mathematical Platonism admits the existence of many mathematical objects for which there is no example or equivalent in the real world. Despite this, many significant mathematicians spent the most prolific years of their lives in Cantor's paradise. The myth was

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[8]Cantor's historiographical and theological speculations remained only a contemporary curiosity, same as Cantor's reasoning on the border between physics and metaphysics.

so seductive that mathematicians liked to believe that the question of infinity was definitively settled. If not indeed settled, then at least it had been caught with the right end.

However, physicists were aware that Cantor's paradise has very little or even nothing to do with the world around us, nothing in common with physics [21]. Additionally, also some mathematicians gradually started to realise the need to abandon that beautiful myth in order to create a set theory (and thus a theoretical basis for the whole of mathematics) in a simpler, more worldly, more secular fashion.

Most of Cantor's "supernatural" concepts, however, are unusable not only in the physical world but are also problematic in terms of mathematics itself. As an illustration, we can mention the concept of the set of real numbers. According to Cantor, real numbers form a set of cardinality aleph one, and therefore, there are many more of them than natural (and rational) numbers. However, the vast majority of these real numbers are "random"—numbers that can't be expressed by any (finite) decimal notation, or by any other mathematical means. They are the so-called incalculable numbers.[9] By title alone, "an incalculable number" appears to be an oxymoron or even nonsense. Isn't it just a "maths joke", as declared in 1927 by Émile Borel? [22] Or is it referring to the unlimited mathematical God? Borel wasn't alone in questioning the meaningful existence of these "incalculable numbers" and was joined by Charles Peirce and Kurt Gödel. At first, Cantor himself also hesitated. Finally, he decided to accept them and reached the uncountable, innumerable infinity. In a relatively simple way, Cantor later reached even greater infinities. All he needed to do was to create powers set, that is, sets of all subsets of the given set. This power set has a greater cardinality than the original set. In the creation of power sets, it is possible to continue without end. This is guaranteed by the so-called Cantor theorem, which is de facto an axiom-definition[10] assigning existence to these sets.[11] The existence ensured by this "mathematical aid", however, is quite doubtful. It is just a proof of existence, unconstructive definition because we have to our disposal no real construction. "It's possible to do it, but no one can do it" (perhaps God).[12] This is a typical situation with many mathematical theorems, axioms, and proofs. However, is it legitimate to refer to God? What then is the reality of those infinities which create the "Tower of Babel"?[13]

Another flaw in Cantor's theory was that, on its basis, it wasn't possible to build a theory of infinitesimals.[14] These infinitely small quantities already introduced in the seventeenth century by Newton and Leibniz were based solely on intuition. Mathematicians, however, failed to establish this concept exactly. So, they resorted to the definition using limits, that is, the proven potential-processual infinity. However, physicists, as well as some mathematicians,

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[9]It was also Bolzano, who considered the existence of such numbers. According to Vopěnka: "Bolzano completed the real numbers". [20], p. 255

[10]As pointed out by David Hilbert, axioms are from another view definitions.

[11]Later, mathematicians introduced axioms-definitions which were even "wilder" and allowed to "construct" (but rather prove the existence of) even larger infinities.

[12]There are many more of these non-constructive axioms in the theory, namely the axiom of choice.

[13]A similar situation occurs with mathematical functions, most of which also can't be described mathematically or otherwise. How is it then with their reality? [21].

[14]Cantor himself denied this possibility: "infinitely small did not exist"! However, Abraham Robinson later managed to construct the concept of infinitely small within the framework of Cantor's theory. His construction was, however, complicated and without any practical impact.

continued to use the non-exact, intuitive definition, and they successfully worked with it [23]. What does this mean for the importance of the foundations of mathematics?

Despite these reservations which remained only in the subconscious of mathematicians, the higher infinities were eventually adopted. Some mathematicians, however, didn't accept them, and their world didn't collapse. In a certain way, their world simplified.[15] These mathematicians and physicists felt the need to get rid of a mythical Divine Implementer who (more or less manifestly) guaranteed the veracity of axioms and so also the existence of (actual) infinities. This idea was advanced by the Dutch mathematician Luzien Brouwer (1881–1966), the founder of the doctrine of mathematical intuitionism (close to constructivism) [24]. He rejected the concept of actual infinity as non-evident and non-intuitive and, by human means, non-constructible.[16] With the refusal of Cantor's approach, Brouwer also eliminated many paradoxes. For example, for Brouwer, the mathematical continuum (line) isn't anything completed; it's "a media of free emergence".[17] He also considered the dividing sphere as described by the paradox of Banach and Tarski as nonsense.[18]

> With Brouwer, mathematics receives the highest possible intuitive clarity… With pain, a mathematician watches how the majority of theories climbing to a height fades in fog.

> *Herman Weyl*

However, as it happens in a revolution, a new totalitarianism often takes hold in the name of freedom. Brouwer replaced the obsolete "bent" facts with new facts, intuitionistic facts which he understood equally dogmatically. He didn't avoid such oddities as the previously discussed concept of objectively existing random, that is, non-quantifiable numbers.[19] The old myth is replaced by a new one and age-old prejudices with those new and unused. Brouwer condemned Platonism so he could quietly go back to it through the back door. However, before the return, he had swept out a lot of old junk from "Plato's world". Being revolutionary on the one hand and inconsistent on the other became fatal for Brouwer. The intuitionists' approach to mathematics was so idiosyncratic that most mathematicians rejected intuitionism as a "Bolshevist menace", as British mathematician Frank Ramsey (1903–1930) claimed. Mathematicians returned to their proven "rigid mathematical truths", to their traditionally sanctified myths and prejudices, to their mathematical God and to the "supernatural" axioms. They also returned to their "tower of infinities".

Brouwer also met with incomprehension in David Hilbert. In 1928, Hilbert withdrew him from the editorial board of the prestigious Mathematische Annalen. Brouwer then loudly

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[15]The words "in a certain way" are alibism, of course. Something was simplified and conversely, something became more complicated.

[16]However, most present-day constructive mathematicians accept the reality of countable infinite sets. Nevertheless, there are exceptions, see Alexander Esenin-Volpin for a counter-example.

[17]At first glance it would seem that similar concepts were also held by Aristotle. Brouwer, however, understood "freedom" as independence from any rules. This inadvertently led him into a similar situation as Cantor with his "incalculable numbers".

[18]The paradoxical claim that a sphere can be divided into five parts and shifting them and turning them can create two spheres of identical size as the original. Although this can be proved no one can do it. So, what does such a purely existential proof show?

[19]It seems that it was the inconsistency that led to Brouwer's undoing.

doubted Hilbert's mental health. Albert Einstein was also in the dispute. From the perspective of philosopher and physicist, he labelled the dispute a farce and trifling.

3.2. Vopěnka's excommunication of God

We have demonstrated the crucial role God played in the epistemology of higher mathematics. Mathematics was perhaps the last scientific discipline dependent on divine inspiration. In the 1970s, a prominent role in systematic attempts to strip away theological motivations was played by Czech mathematician Petr Vopěnka [25, 26, 27]. He created quite a different set theory based on different assumptions. In his approach, Alternative Set Theory, Vopěnka demonstrated that set theory could be founded in quite a different way without Cantor's paradise, without the "Tower of Babel of infinities", even without an omniscient God. Vopěnka's new approach was not a manifestation of atheism, however, but only a demonstration of the fact that God (whether He exists or not) should play no role in human mathematics.[20] God's knowledge is for us inaccessible and mathematics isn't part of theology. Cantor's "higher" infinities are but a projection of our unabridged fantasy and divine inspiration.

Vopěnka did not ascribe reality to infinities of higher cardinals and formulated the concept of so-called general collapse, according to which it is possible to find a one-to-one correspondence between all infinities. (So, all infinite sets must be equivalent.) This step is in accordance with Bolzano's view, but in strong contradiction with Cantor's approach. However, the contradiction disappears when we reject ascribing reality to these incalculable, innumerable "real" numbers–to these "mathematical jokes".

And in his Alternative set theory, Vopěnka demonstrated that parallel concepts of infinite ensembles can be constructed. And also, that exact construction of infinitesimals is possible. On these ideas, he started to formulate new foundations of mathematical analysis [28–36]. He also derived philosophical consequences of his approach.

Does Vopěnka's approach means that the Platonic realm of mathematical forms does not exist? That this realm (Cantor's or even the Pythagorean paradise) is only our fantasy, a non-obligatory notion? Does it mean that we can build up different mathematical realms and also different foundations of maths? Does it mean that we might accept the Aristotelean viewpoint (i.e. nominalism), in which Plato's ideas-forms are but our common names? Or does it mean that we should accept "postmodern" approach according to which "everything goes"?

However, Vopěnka's answer to these questions was emphatic no! He did not accept these courageous views. The reason was perhaps psychological. While young, he flirted with phenomenological philosophy and empiricism. When mature, he abandoned such ideas and returned to the "certainties of Platonism" or, more precisely, to certainties of "his own mathematical Platonism". He relied on the existence of "a single eternal mathematical realm", albeit no longer with the enticing recesses of that "ornamental neo-Baroque superstructure"–Cantor's paradise of sets. Shortly before Vopěnka left this world, he even stopped considering his Alternative Theory (with a capital "A") to being an alternative (with a lower case "a") and

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[20]Attracts motivated by atheism really appeared at the beginning of twentieth century. They originated by renowned French mathematicians.

regarded it as the only possible one. He completely rejected classical Cantorian set theory and renamed his own the "New set theory" because "there exists no alternative". He replaced the old "religion of mathematics" with a new one, which was less divine and less metaphysical, but again, the only true one.

Vopěnka's intellectual development reminds us of Nicolas Copernicus. Copernicus moved the centre of the universe from the Earth to the Sun and by this step (perhaps unconsciously) raised the question as to whether there actually is any centre at all. However, Copernicus himself was afraid of this overly revolutionary idea and he did not leave the bounded, final universe closed to the sphere of fixed stars. Vopěnka later cancelled Cantor's theory as the sole basis of mathematics. By this step, he evoked the idea of whether mathematics should have a single, metaphysical (metamathematical) basis or whether it can be established with various alternative (better said, parallel) ways. Even the name of his theory directly points to alternativity. However, like Copernicus, Vopěnka also backed and marked his own theory as the only acceptable and therefore renamed it "The New" because "there is no alternative", as Vopěnka proclaimed [37].

What about other mathematicians? We must admit that the impact of Vopěnka's ideas was very limited.[21] Tradition is firmly rooted in our collective unconsciousness and tends to be stronger than reason. Thanks to tradition, the old mathematical "religion" still survives, and the new approaches have only a negligible impact. Time will tell for how long.

3.3. Religion, mathematics and pragmatism

Within the framework of mathematics, physics and what we call "reality", the nature of infinity is non-apparent and metaphysical, much like the nature of God. It is left to us to admit its existence or not. And the one we choose, the one we create is the one we are stuck with. Our choice cannot be entirely arbitrary, of course. It depends on the overall concept of mathematics, and possibly also on that of physics. So, it depends on the philosophy of mathematics and physics, that is, metaphysics. The choice of a metaphysical system is dependent not only on our rational considerations but also on our subconscious beliefs, on our faith, on our "religion" (or religion without quotation marks). However, it should first and foremost take into consideration its utility in real mathematics and physics, that is, how it can be used in practice. Infinity is primarily our tool to understand the world which is finite. This does not imply short-sighted pragmatism, of course. The usefulness of our tools might only be apparent after some period of time, and there is no way to determine it in advance. Reliance on intuition is the only possibility.

Let us recall the hesitant approach of young Bolzano towards religion. Under the influence of the Enlightenment and rationalism, he doubted the supernatural origin and content of the Biblical message as likely a myth, a fallacy. It seemed that Bolzano doubted the very basis of faith. However, he overcame his doubts and eventually became a preacher of that faith. He realised that the supposed divine origin isn't what was the most important. More fundamental is the good that religion brings to mankind. What seems to be the real foundation is only a formal basis, while the true foundation lies elsewhere. Therefore, "not true but useful" or even "truth = usefulness". This exact sentiment is echoed in the philosophy of pragmatism.

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[21]So poor was the impact of other "alternative set theories". For the overview see [38].

Imagine: If it is proved that no miracles happened and that everything is just a myth, then the church wouldn't collapse.[22] However, if religion has nothing to say to people! it cannot dispense the "good", the cathedrals will become dead monuments over time and the church itself will die. The strength and weakness of faith lie in the practice of human life. A practice which elevates people, which is beneficial to them, which leads them to good and successful ends, such practice is also the right foundation and the right argument for faith and religion.

> *…it is quite indifferent if a certain doctrine of the church was established later, or if its formation and expansion are also due to a fallacy.*
>
> *In religion, especially in God's revelation, it is not at all about what a thing itself is but what conception of it elevates us the most.*
>
> Bernard Bolzano, *Autobiography* [13]
>
> *Objective truth, in which the feature satisfying human desires doesn't have any role whatsoever, doesn't exist…*
>
> *Independent truth is only the dead heart of an empty tree.*
>
> William James, *Pragmatism* [39]

Similarly, I believe that it is advisable to use the Bolzano pragmatic way to approach science, including mathematics. The formal "ontological under-building" of mathematics–the set theory–is a monumental work on which mathematicians practiced their art. Yet it is only a formal basis. What is important is what mathematics brings to mankind and what it could bring even if it were built on a different basis. If mathematicians discovered (or rather accepted) that the set theory is just a myth or fallacy and that there are no infinities, the mathematics wouldn't collapse. If, however, mathematics couldn't be used in the earthly world, if it weren't beneficial for practice (therefore not providing "Bolzano's good"), it would become a purposeless game, such as chess, checkers and go. The strength of mathematics lies in the practice of life and it is this practice–that is real, applied mathematics–that is the most real justification and foundation for the entire of mathematics.

The above-mentioned conclusions can be illustrated by two examples. First, we can examine the pragmatic approach of Abraham Robinson, the founder of non-standard analysis. In 1964, he concluded that actual infinity doesn't exist–neither in a real nor in an ideal sense. However, Robinson reassures us: the absence of actual infinity means nothing for practice and for mathematics! We are supposed to ignore this fact and pretend that nothing is happening! [40]

The second example brings us back to Petr Vopěnka. He approached the expected absence of actual infinity (represented by infinite sets) quite differently. He deemed it necessary to redo all the foundations of mathematics. And he undertook this ambitious task himself. The effect, however, wasn't as significant as he probably expected. Those new foundations did not provide much that couldn't be obtained from the disputed traditional foundations.

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[22]I mean mainly Catholicism. Newer denominations such as Protestantism and Islam approach the miracles in a more sceptical way. Finally, Mohammed performed no miracles and "rational" Thomas Aquinas thought it was a symptom of his inferiority!

What do these cases demonstrate regarding the importance of the foundations of mathematics? What does that say about the conception of infinity?

> *There may be very different mathematical foundations as well as different superficial details if the results needed for the real world can rely on them.*

Richard W. Hamming [41]

> *We have found a strange footprint on the shores of the unknown. We have devised profound theories, one after another, to account for its origins. At last, we have succeeded in reconstructing the creature that made the footprint. And lo! It is our own.*

Arthur Eddington [42]

4. Conclusion: science, theology and epistemology

Throughout history, we are aware of many examples wherein theology hampered the development of philosophy and science. This applies especially to the fundamentalistically understood religions which were doing a disservice to astronomy and to all natural science, in fact. As we have seen, the situation was different in mathematics. Monotheistic religion served with an inspiring vision of an all-knowing God who was transformed into "the god of mathematicians".

Mathematicians relied on God; He was the guarantor of the metaphysical world of mathematics. Throughout the advent of modern times, mathematicians slowly began to realise that mathematics isn't a part of or an extension of theology. They gradually left the theological "proofs of infinity"; more specifically, they stopped talking about God. However, God survived in the depths of their collective unconsciousness. Most mathematicians never got rid of this hidden God or "supernatural concepts"–axioms guaranteeing the existence of large, highly "unnatural" infinities, the continuum hypotheses, the axiom of choice, etc. By declaring these "holy truths" through their mouths, they only provided God with a disguise.

In the mid-twentieth century, some mathematicians (or rather philosophers of mathematics) timidly began to realise the limitation of this Theo-Platonic approach. They emboldened themselves and tried to formulate the "God-free" foundations of mathematics. Nevertheless, on a deeper philosophical layer, Platonism still was hidden there (Brouwer, Vopěnka…). One "mathematical religion" was exchanged for another. One that was less theological and less metaphysical, perhaps "more scientific", but again it was the only real and true. Despite this effort towards new foundations of mathematics, the practical effect was negligible. Mathematicians are conservative people; like most of us, they don't like to abandon their prejudices. However, there is a more rational argument: their mathematics "works". However, this is not an argument against different foundations of mathematic, because "working mathematics" can also be based completely differently. The reason is that the factual foundation of mathematics is the real mathematics, that is, applied maths.

But, were the substantial effort of Georg Cantor and other mathematicians all for naught? Was it all leading to a dead end? I am not of this view. Even if Cantor's paradise vanished for good,

even if it became a mere myth or simply a beautiful dream, the metaphysical excursions of nineteenth and twentieth century mathematics would not have been in vain. Neither would the pilgrimage to "God's mind", and to "divine infinities". This journey provided a great deal of experience and inspiring insights. Mathematics returns from these voyages changed, much richer, more experienced and much stronger.

Although I accept the practice as the ultimate criterion, I am aware that the first-pragmatism isn't sufficient for the foundation of science. Neither mathematics nor science can do without a metaphysical overlap, without "myth" or "religion". We as people can't do without it either. Only metaphysics, the "irradiation of a spiritual light", provides an understanding of things and incorporate them to science and to our life. Only metaphysics creates sense and provides a story.

> *Just as the light of the sun irradiates the organ of vision and things visible, enabling the former to see and the latter to be seen, so too the irradiation of a spiritual light brings the mind into relation with that which is intelligible.*

> *Robert Grosseteste*[23]

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Revisiting John Locke for Thinking About the Global Age: Knowledge, Politics, Religion, and Education

Gustavo Araújo Batista

Additional information is available at the end of the chapter

Abstract

Theme of this text: importance of John Locke´s thought, British empiricist philosopher, concerning knowledge, politics, religion and education in global age. Question one searches for answering: nowadays, in global age, why is a thinker like John Locke still so important in order to support reflections about epistemological, political, religious and educational questions? Kind of research reported is a theoretical approach. Discourse development has followed these steps: first, considerations about his theory of knowledge; second, approaches concerning his political theory; third, reflections under his ideas on religion; fourth, discussions concerning his thoughts over education. Results of this inquiry: he is one of the most eminent theorists of experience and it is essential to build knowledge; therefore, his thought must not be neglected; he is also very important to reflect about natural rights of mankind, which must be granted by Commonwealth; his ideas over toleration, which reinforce distinction between Church and Commonwealth, are still useful to think about how to deal with several religious beliefs and political opinions; his educational thought outlines that education is a psychophysical process that must equally treat both body and soul. Then, he must be recommended and also revisited in order to think about present global age.

Keywords: education, epistemology, John Locke, philosophy, politics, religion

1. Introduction

John Locke (1632–1704), English modern philosopher, is an empiricist thinker whose works have contributed to thinking about the conception of modernity. His ideas concerning knowledge, politics, religion and education, for example, have helped to make a world view based on these values: experience, science, philosophy, freedom, equality, toleration, civility,

reasonableness, virtue and self-domain. Thus, he is one of the most important minds who described the modernity, which has as one of its consequences the global age. So, revisiting him means to look for one of the foundations which makes possible to explain and comprehend the present world, because John Locke's works sum the modernity up.

This text intends to select some of John Locke's works, in order to respectively discuss about his conceptions of knowledge, politics, religion, and education; they are: *An Essay Concerning Human Understanding, Two Treatises of Government, A Letter Concerning Toleration* and *Some Thoughts Concerning Education*. Some of his key ideas inside those works will be brought to this discussion, because they are still profitable to reflection about global age; that is: some questions thought and answered by Locke are also present questions; so, his epistemology still offers elements to think about knowledge in general and, especially, about science and technology; his political theory is useful to treat legal society, state, and property; his ideas about religion are able to argue against the lack of toleration around the world; his educational thought may help concerning how to prepare people to be intellectually and morally virtuous, living according to reason rules.

Revisiting John Locke is an opportunity to think about questions which overcome ages, because he is a philosopher; so, his thoughts are about eternal, general, or universal questions. Moreover, there are problems, which are not definitively solved; thus, his reflections and answers may help to find new ways to deal with new challenges which still stay before the present mankind. As in Locke's times, nowadays one deals with theoretical and practical problems about knowledge, because its increase and expansion bring other challenges; the same may be said about politics, because there are many factors which raise many questions about power, property, and droit legitimacy; concerning political and religious toleration, at the present time, the mixture between politics and religion around the world raises again problems of violence against different viewpoints in matters of both faith and government; under education, the priority of moral formation in relation to intellectual formation outlines the importance of the training conducted in the pedagogical process.

Finally, this text shows, under John Locke's perspective, that it is imperative to rescue the importance of the philosophical tradition, in order to rethink many ways which perhaps are not right, because there are several risks in the global age whose causes are the lack of a philosophical reflection about many ideas, values, and actions; for example: aggression to environment in a world scale; increase of violence around the world because of ethnic, political, and religious causes; life standard in practically all countries based only on economic prosperity. Due to its dangerous consequences, perhaps John Locke's philosophy may help how to find another way to direct the global civilization.

The plan of this text is this: First topic: some of John Locke's ideas about epistemology or theory of knowledge; second topic: some ideas of his political and social theory; third topic: some of his ideas about toleration; fourth topic: some of his ideas concerning education.

2. Some ideas concerning epistemology or theory of knowledge, according to John Locke

Because John Locke is one of the most important authors who represent the British Empiricism, his ideas about knowledge must not be neglected. Thus, especially in this topic, some of his epistemological ideas will be treated and his work from which his ideas will be extracted is this: *An essay concerning human understanding*; it is divided into four books; in the first, Locke discusses about notions or principles, both theoretical and practical; in the second, he treats ideas; in the third, he deals with words; in the fourth, he deals with the distinction between knowledge and opinion.

This text will follow the same division adopted by Locke in his aforesaid work, in order to show his ideas which sum his epistemological thought up. However, before discussing about some of the contents of the four books of his essay, it is also profitable to offer the main topic of that work, that is: the understanding. In *The epistle to the reader*, a kind of general introduction to his work, Locke outlines the importance of knowing the understanding, that is, according to him, the superior power of the soul, due to which, it is possible to look for truth (supposed finality of thinking), as well as to find pleasure (supposed finality of feeling). It means that, by understanding, the human being is able both to think and to feel. Thus, being both reasonable and sensible due to understanding, if he searches for knowing this own understanding, then, he will find self-knowledge.

In the first book of his essay, Locke denies every kind of innate principles in the mind, both theoretical and practical ones. He states that only acquired principles are possible, because, arguing against those who defend innate principles, whose arguments are based mainly on general acceptance, he wrote:

> *Universal consent proves nothing innate*. This argument, drawn from *universal consent*, has this misfortune in it, that if it were true in matter of fact, there were certain truths, wherein all mankind agreed, it would not prove them innate, if there can be any other way shown, how men may come to that universal agreement, in the things they do consent in; which I presume to be done [1].

If there are no innate principles, then, they cannot be supposed by acceptance or appeal, because both are only a matter of convenience and it is just how they decide or want to be, not how things really are or seem. According to Aaron:

> We cannot then argue from universal assent to the innateness of the knowledge of the principles. Nor again is it possible to claim for such knowledge any priority in time. Clearly the knowledge of the principles, abstract as it is, comes late. Sensation, recognition, seeing that read is not white, are all prior to our knowledge of the principle of non-contradiction. It is strange that the last named, none the less, should be singled out as a 'native inscription' [2].

There is no way to Locke but this: rejecting all kinds of principles, even those that can be universally accepted or requested. Therefore, there will only be principles, which the mind will conceive by itself, through ideas drawn from experience. Because of his position, Locke became one of the biggest adversaries of the doctrine of innate ideas. Summarily:

> According to this doctrine, certain fundamental components of human knowledge are inborn rather than acquired by processes of observation, learning and reasoning – inborn because they are part of the very frame of the human mind as God designed it. In virtue of their supposedly divine source, these components of human knowledge were not to be questioned or doubted, in the view of upholders of the doctrine – many of whom had vested interests of a religious or political character which could, by this device, be placed beyond the scope of publicly acceptable criticism. Locke's fierce opposition to the doctrine of innate ideas was undoubtedly motivated, at least in part, by his hatred for the cloak that it provided for obscurantist and authoritarian dogmas [3].

In the second book of his essay, after denying innate principles, Locke makes his next step against innateness: there are no innate ideas. It is the second moment of his attack on the doctrine of innate ideas. Although the term "idea" was already employed by innateness upholders, Locke assumes it and shows his own definition of that term:

> Idea *is the object of thinking*. Every man being conscious to himself, that he thinks, and that which his mind is employed about whilst thinking being the *ideas*, that are there, 'tis past doubt, that men have in their minds several *ideas*, such as are those expressed by the words, *whiteness, hardness, sweetness, thinking, motion, man, elephant, army, drunkenness*, and others: it is in the first place then to be inquired, how he comes by them? I know it is a received doctrine, that men have native *ideas*, and original characters stamped upon their minds, in their very first being. This opinion I have at large examined already; and, I suppose, what I have said in the foregoing book, will be much more easily admitted, when I have shown, whence the understanding may get all the ideas it has, and by what ways and degrees they may come into the mind; for which I shall appeal to everyone's own observation and experience [4].

If there are no innate ideas, then, they must have another origin. Like an empiricist philosopher, Locke argues that experience is only fountain of ideas. Summing up, it is both sensation and reflection. Sensation is an exterior sensorial affection (external experience). Reflection is an interior mental operation (internal experience). Together, sensation and reflection provide for the mind every kind of ideas. Surely, experience is not innate, only acquired. Therefore, ideas depend on it, that is: they come from it; they are limited by it; they are changed by it; there are no ideas without experience; that is: no experience, no idea; no idea, no thinking; no thinking, no reason; no reason, no human life; no human life, no human being.

In the second book of his essay, Locke works on describing his theory of ideas. It is an exhaustive discourse about the nature of ideas, which explains with a richness of details the prime matter or the former subject (*materia prima*) of knowledge and also of reason. According to Lowe:

Locke seems at least sometimes to be using the term 'idea' to refer to such experiential features. However, he also uses the term at times to refer to what we would now call *concepts*, that is, the meaningful components of thoughts that we may entertain about the world and attempt to communicate to one another in language – such as the thought that this apple is red and that one green. But, as I also indicated earlier, it would be unfair simply to accuse Locke of a confusion between percepts and concepts, because it is part of Locke's very project in the *Essay* to forge a link between our conceptual resources and features of our perceptual experience. The dual role played by ideas in Locke's kind of empiricism is essential to this project [5].

In the third book of his essay, by dealing with his conception of word, first of all, Locke upholds that language is an essential faculty of mankind, a gift from God, its creator; thanks to it, men can live together in community.

However, as he also adds, language is not simply the ability of producing articulate sounds (words); moreover, there must be ideas to support them; that is: according to Locke, language is an association between ideas and words, whose end is to set communication among people; so, ideas furnish meaning for words, as well as words furnish signs for ideas: that is the nature of their association.

Through language, ideas and words combine in order to make human beings understand one another. It is not only important for their mutual communication and their community life but it also makes possible to share and to spread knowledge among them, although there are risks of misunderstanding, because the communication process is not perfect. It means that:

> The purpose of language is to expand the knowledge of each of us by allowing us to communicate our ideas, and especially our general ideas, to others, and to acquire new ideas from them; but as we have no direct access to the ideas of others, and no way of determining upon a scheme of general terms without choosing criteria to define the boundaries of species ourselves, we can have no guarantees that we will use our language to say the same things about the same objects and thus that we will succeed in the communication of ideas at which we aim [6].

In the fourth book of his essay, there is a distinction between knowledge and opinion (also called assent, belief, or faith by Locke); although both seem to be the same thing (because they are no doubt together), Locke occupies himself with separating them, because if there is confusion between them, there will be error and it is opposite to the search for truth, indeed. Moreover, upon the question concerning the difference between knowledge and opinion, there is a difference between science and religion, so precious to Locke, because, according to his thought, they are possible to coexist in harmony. According to Wolterstorff:

> Locke held, indeed, that assent always accompanies knowledge; but he denied what has become a fundamental tenet of epistemology in our own day, namely, that knowledge is a *species* of assent. Assent or belief, says Locke, is *taking* some proposition to be true, whereas knowledge is *seeing* it to be true. To know is to be directly acquainted with some

fact, to be immediately aware of it, to perceive it; or, to put the point from the other side, knowledge occurs when some fact is presented directly to the mind [7].

Locke's definition of knowledge reinforces his empiricist perspective, because his conception of knowledge is nothing but the consequence of his conception of idea; that is: from his theory of idea, he comes to his theory of knowledge. Perception is the keyword; it is one of the powers of mind; by making use of perception, mind discovers if there is connection (agreement) or disconnection (disagreement) between at least two ideas inside itself. According to Locke, there are two perspectives of knowledge: one is positive, because it refers to a presence of link between ideas, and another is negative, because it refers to an absence of link between them; however, in both cases, there is mind perception:

> *Knowledge is the perception of the agreement or disagreement of two* ideas. *Knowledge* then seems to me to be nothing but *the perception of the connection and agreement, or disagreement and repugnance of any of our ideas*. In this alone it consists. Where this perception is, there is knowledge, and where it is not, there, though we may fancy, guess, or believe, yet we always come short of knowledge. For when we know that *white is not black*, what do we else but perceive, that these two ideas do not agree? When we possess ourselves with the utmost security of the demonstration, that *the three angles of a triangle are equal to two right ones*, what do we more but perceive, that equality to two right ones necessarily agree to, and is inseparable from the three angles of a triangle? [8]

This sentence summs simply up Locke´s conception of knowledge: ideas' agreement or disagreement perception is made by the mind. However, the mind is not always able to perceive both connection and repugnance among ideas. Then, it can resort to its other powers in order to obtain something not necessarily true, but supposedly true: that is just the nature of faith, born from probability, not from certainty. According to those aforesaid explanations about Locke's epistemology, one verifies that it is very useful in order to think about knowledge in the present global age. If Locke argues that experience is unique source of ideas, then, he also argues against innateness; he admits that there are only acquired ideas; therefore, all knowledge is also acquired. That theory is very profitable to combat every kind of dogmatism: if experience is contingent, so are its ideas.

Knowledge is made by depending on ideas conceived; it is because there is no reason to conceive absolute truth, in matter of knowledge, which is circumstantial; that is: relative to human experiential capacity and limited by several factors, internally or externally; finally, experience is not perfect yet, although it is perfectible or progressive:

> In the Locke's view, then, though we are fitted to know some things, we are not fitted to know everything. The most obvious and large-scale limitation is the lack of scientific knowledge in natural philosophy, but there are others that Locke cites – all of them standard and frequently cited problems in seventeenth-century philosophy [9].

Besides, experience is not only individual; it is also social. Therefore, it is generally, relative to culture, age and place; specifically, it is relative to several factors which could be mentioned here. Anyway, according to Locke's perspective, experience is a human production. Mankind

produces its experience along history, but not without difference, diversity, or peculiarity; it means that: several human commonwealths, during their existence, have left behind them their legacy, according to their relations with their world; that legacy is the best proof of their experience. For ages, history has witnessed people after people disappearing, others still subsisting. As the last resort, there is no reason to consider this civilization better than that one. It is only a matter of different experiences, extracted from these approaches about Locke's thought. Then, this apology of his thought, based on his epistemology, shows that his theory of knowledge is helpful to think about and promote respect for the diversity of experiences around the world, because each person and people deserve to be respected according to their peculiarity.

3. Some ideas concerning political and social theory, according to John Locke

As a political and social philosopher, John Locke is a thinker whose works make him belong to liberalism. Although that term is to be very equivocal, due to many meanings which has assumed (economically, politically, and religiously), summarily, liberalism is a doctrine, raised in Modern Age, for which the keyword is freedom. According to liberal thought, freedom is one of the fundamental or natural rights of mankind in general, and, especially, of an individual. Locke's liberalism upholds that, as well as freedom, there are other rights by nature, like these: life, equality, and labor; only one word is able to sum them up: property.

In Locke's *Two treatises of government*, there are his main ideas which make his political and social theory. The first part *(First treatise)*, is, particularly, a refutation to Sir Robert Filmer (1588–1653), whose book, summarily entitled *Patriarcha*, is an apology to the theory of divine right to absolute monarchy. The second part *(Second treatise)* is, generally, Locke's explanation of his political and social thought, although there is another author, whose ideas are especially refuted, too, Thomas Hobbes (1588–1679). However, these are not two independent Locke's works, because there is unity between them. Thus, what Locke particularly refuses in his first treatise, by attacking Filmer's ideas, he generally affirms in his second one, by defending his ideas as principles of all rightful government, as well as he especially denies some of Hobbes' ideas. In order to demonstrate it, Filmer's and Hobbes' main tenets and arguments will be shown and after their refutation by Locke.

(A) About Filmer's main tenets and arguments:

First: Freedom is not a natural right, because nobody has been born to be free.

Second: The first kings were also fathers of families; then, their subjects ought to obey them as well as children ought to obey their parents.

Third: All government is absolute monarchy, because it is the base of all kinds of governments.

Fourth: It is unnatural for people to govern or choose their governors, then, only God loyally chooses kings to absolutely rule their subjects: "God must *eligere* [choose], and the people only

do *constituere* [set up]" [10]. Nevertheless, if people reprehend or uncrown their kings, it is not fair, because only God could do it.

Fifth: Positive laws do not infringe natural and fatherly power of kings; they are above them and they are above them because they are before them, by will of God.

(B) About Hobbes' main tenets and arguments:

First: Freedom and equality are the natural conditions of mankind. This is his conception of freedom: "Liberty, or freedom, signifieth properly the absence of opposition (by opposition, I mean external impediments of motion); and may be applied no less to irrational and inanimate creatures than to rational" [11]. It is a negative definition of liberty, indeed, because it only refers to lack of obstacles, but there is also a positive definition of freedom in Hobbes' thought, if one understands that it is right to everything, like this: "For where no covenant hath preceded, there hath no right been transferred, and every man has right to everything and consequently, no action can be unjust" [12]. Concerning equality, Hobbes upholds that men are essentially equal in essence, because their differences are after their creation.

Second: Competition, diffidence, and glory are the three main causes of quarrel among mankind, that is: although men are to be free and equal among them, there is a tendency to selfishness, because they put their own interests before others' interests; that is the path to state of war.

Third: Mankind is its own menace, because state of nature's tendency is to become state of war; that is: man perverts into his own danger (*homo homini lupus*): "To speak impartially, both sayings are very true; That Man to Man is a kind of God; and that Man to Man is an arrant Wolfe. The first is true, if we compare Citizens amongst themselves; and the second, if we compare Cities" [13]. Because of the right of each individual to everything, there are some whose inclination is to the same thing, as well as to infringe others' rights. Therefore, spread of violence (*bellum omnium contra omnes*) becomes unavoidable.

Fourth: An artificial man is needed in order to avoid mankind's self-destruction, that is: the Commonwealth. Hobbes compares the State to the biblical Leviathan, the most powerful sea dragon, which, according to the legend, is also described like a big fish or a big snake or a big octopus; it is a symbol of domain, force, and power. Thereby, Hobbes borrows that mythological sea monster in order to offer his Commonwealth metaphor, whose domain must be absolute, whose force must be incomparable, and whose power must not be restricted. It means that, in the last resort, without a supreme and absolute power to restrain mutual menace from each human individual, there is only a state of war among them, indeed. Therefore, men require an unconditional and unrestricted authority over themselves, for their own good, because, according to Hobbes' thinking, it is the very way to reestablish, at last, peace among them and, overall, their mutual conservation; there is no end to Commonwealth but it, whose functions, members, and organs also correspond to those of the human body.

(C) About Locke's main tenets and arguments:

First: State of nature is a condition of liberty and equality among men (against Filmer and according to Hobbes), but it is not a state of war (against Hobbes); it is also a condition of

reasonableness, because everyone is under reason laws, which are, according to Locke, the same nature laws. Thus, freedom, equality, reasonableness, and peace are natural human properties, because, mutually and potentially, everybody was born to be free, equal, reasonable, and peaceful. Therefore, in the state of nature, there is no reason for slavery, superiority, inferiority, or brutality to exist among humanity; they can only be after the state of nature.

Second: There are differences among these powers: paternal (or maternal), despotical, and political (just against Filmer; Hobbes does not develop this kind of power theory, because he is only interested in the absolute power of Commonwealth). Filmer argues that power is only one thing, emanated from God to kings over subjects, as well as the parents' authority over their children or the masters' domain over their servants; under Locke's perspective, if Filmer was right, then, there would neither be freedom nor equality, among people; moreover, the social contract would be meaningless. Thereby, there must be different kinds of powers because there are several ways of relationships among people. Basically, there are three kinds of relations among people, with their respective powers; those are:

a. Among husband, wife, and children (family); paternal power of parents over their children, due to blood relations; it consists in the right of parents' care, concerning their children's breeding, before they can reach their own independence, thanks to their own reasonableness.

b. Among lords and slaves (slavery); despotical power of lords over their slaves, due to permanence of state of war; it consists in the right of victorious men (lords) over lives of loser ones (slaves), because, if a man declares war against another and loses it, then, he who wins becomes the owner of his life and there is still a state of war between them; thus, it is a part of the right of self-preservation.

c. Among citizens (citizenship); political power of citizens over themselves, due to social contract, set under explicit or tacit consent of free and equal individuals among themselves; it consists in the right of sovereignty concerning making, exercising, and protecting commonwealth laws in order to deal with properties of each member of it, internally and externally. Thus, political power is made of three parts: legislative, executive, and federative.

Third: Formerly, there are three kinds of government: monarchy (elective or hereditary), oligarchy (or aristocracy), and democracy, mixed forms of government also being possible, like a constitutional monarchy, which combines crown and parliament (against Filmer and according to Hobbes). Anyway, supreme power always derives from all citizens, because sovereignty is always theirs and so they can choose how they want to exercise it.

Fourth: Commonwealth is established by social contract, among human individuals, who are also free and equal, reciprocally; therefore, sovereignty comes from them, not from God to kings, because it is really impossible to know whom God has chosen to become some governors and others governed; on the contrary: God has become sovereign for all mankind over creation, according to biblical texts, which Locke makes use in order to support his argumentation (against Filmer and according to Hobbes).

Fifth: Governors, even kings, are people's, not God's, chosen ones, in order to accomplish their interests, that is, summing up: to protect their properties. It means that they are not owners of sovereignty, only citizens are its rightful owners, but they carry it out under their consent. Thereby, governors are just civil officers and then they can be dismissed according to the citizens' will, as well as it is rightful that subjects may resist their sovereigns, if they do not accomplish laws endorsed by social contract members, because there is nobody above any laws (against Filmer and according to Hobbes, who is, like Locke, a social contract philosopher).

Locke allows concluding that there is no utter power over subjects, but over sovereigns, being exercised by subjects. It is just opposite to Hobbes, whose thinking upholds that, once established, sovereignty is unconditional, that is: it is not beneath changes of interests of subjects; so, insurrection is not lawful and civil war is like Commonwealth death, which signifies the return to state of war. Every government, according to Locke, gets into a tyranny, if it does not preserve properties of its citizens, because, on doing so, it diverts finally to which it has been made and there is no way for people except rebellion:

> The end of government is the good of mankind: and which is best for mankind, that the people should be always exposed to the boundless will of tyranny; or that the rules should be sometimes liable to be opposed, when they grow exorbitant in the use of their power, and employ it for the destruction, and not the preservation of the properties of their people? [14]

There are two columns that support Locke's political and social theory: state of nature and state of society; upon them he bears his tenets. If there are both natural and social dimensions inside every human being, then, he belongs both to nature and to society. Like a natural being, he has natural properties (such as aforesaid: liberty and reasonableness), which belong to him all his life, unless he may infringe some laws that could make him unworthy of them (for example: if he unfairly makes an attempt on somebody's life, he will lose his freedom), or even when something happens to him that results in the loss of some of his faculties (for example: if he achieves some kind of madness and so his reason will be unavoidably lost). Like a social entity, he has social rights and duties. which function to preserve his natural properties, as well as those of the rest of the limbs of political body. There is more than a concrete, economical, or material perspective into Locke's political and social thought, because property is also an abstract, immaterial, or moral question, derived from the natural state and granted in the civil state. According to Ashcraft:

> One of the purposes of Locke's employment of the concept of the state of nature, however, is to undermine the force of the presupposition that political authority is simply derived from and reflective of the social relations of property ownership by showing that political authority must be linked with the consent given by persons who are equal and independent. Hence, there is a moral autonomy to the realm of politics. The latter, for Locke, could never be understood merely as the protective outgrowth of the interests of property owners [15].

As much in natural state as in the civil state, each person is into morality, due to rationality, which is universal. Nature, society, moral, reason, and property are mutually linked and considering them utterly disconnected would be a mistake. Thus, Locke's political and social theory is still profitable in order to think about the global age, because henceforth property is not only a national matter anymore, as well as relations among commonwealths wrap questions up, which, directly or indirectly, may affect the rest of the world, both environments with their resorts and people with their cultures.

4. Some ideas concerning toleration, according to John Locke

Discussing about Locke's thought concerning toleration is really a current debate, because his context was not so different from the present day. During the seventeenth century, religious wars and political persecutions caused by intolerance were common. Nowadays, unfortunately, intolerance is still a real menace. It can be explicit or implicit. Very often, it appears when some people, under the name of their beliefs, commit disrespectful acts against other people who do not share them, such as physical or moral aggressions. Rarely, there are churches or sects that do not promote recrimination of other ones for self-profit. The same could be said of political ideologies or opinions. Therefore, dealing with intolerance, politically and religiously, is a continuous challenge; Locke's ideas about it are very useful in order to clear and to distinguish some aspects of politics and religion; it is because this one of his works, entitled *A Letter Concerning Toleration*, is able to provide arguments to those who intend to treat that theme. Just three of Locke's arguments are enough to sum up his thought about political and religious toleration.

First: The argument of the care of one's own soul about religious matter: it consists in affirming that, each person, like a free and reasonable being, is able to deal with his own spiritual and secular destiny; that is: under a religious perspective, eternal happiness (redemption or salvation) supposes a belief that each individual adopts for himself; it becomes faith and intimate forum matter, because it can only be considered as one if the person in question is convinced of it; so, nobody can exercise his own faith for nobody; thus, none should impose it to none, no matter what his condition or intention. Church, according to Locke, is a kind of society that results from the rights both of association and of expression in matter of beliefs:

> Let us now consider what a church is. A church then I take to be a voluntary society of men, joining themselves together of their own accord, in order to the public worshipping of God, in such a manner as they judge acceptable to him, and effectual to the salvation of their souls [16].

Church and Commonwealth are distinct societies, not in relation to their principles, because both should suppose freedom and equality among men; however, their finalities divert, because it is supposed that the end of Commonwealth is to preserve property, as well as it is supposed that the end of Church is to deal with spirituality. Moreover, religious imposition does not take

part in social contract; it would be opposite to individual natural freedom; therefore, there is no reason for public powers to occupy themselves with imposing beliefs on citizens.

Second: The argument of the exclusion of the civil or political authority in matter of religion: it consists in both enlargement and deepness of the aforesaid argument, because Locke reinforces that religious or spiritual questions overcome the jurisdiction of the public power; civil authority is just able to deal with questions in matter of preservation of properties of citizens. Commonwealth has no end but protecting interests of their members, but extension of its power does not reach spiritual human dimension; however, Commonwealth must neither allow nor promote religious intolerance, much less make use of violence in order to do it, because it would become a social problem due to the tendency to religious fanaticism of some citizens; on the contrary: all religions must be considered equal before it; summing up: Commonwealth should only make use of external force (coercion) in order to keep the social peace; Church should only make use of internal force (persuasion) in order to keep the spiritual peace.

Third: The argument of the inefficacy of the coercion of the civil or political authority in matter of religion: it consists in this reasoning: if somebody is not persuaded concerning whether a religion is really the best for him, among the several ones that are at his disposal, then, why sovereigns would be rightful about repressing who is not adept of his personal religion or even of the official religion of his country, for it is just out of use? Locke outlines the personal responsibility that each one has about his own beliefs, adding that all legislation that may incite religious intolerance is as unnecessary as useless. Besides, it would be as lawless as unreasonable, for being opposite to reason. Because reason is before social contract, civil, political, or social laws have no end but to enlarge and to deepen and to reinforce natural, reasonable or universal laws to which all mankind is subjected.

According to Locke, intolerance, politically and religiously, is opposite to: freedom, equality, and reasonableness; then, it is also opposite to property. Thus, if Commonwealth makes use of political and religious intolerance, it will be not lawful. However, there is a way to justify intolerance, that is: when Commonwealth turns to it in order to avoid or to stop social chaos, nurtured by political or religious fanaticism. Therefore, intolerance is paradoxically lawful, whether it is at service of reason, in order to preserve every member of social contract; that is:

> If an individual as the result of his religion does positive harm either to another individual or to the state, then he cannot be permitted to practise his religion. For instance, a religion having human sacrifice as part of its ritual could not be tolerated in any modern community [17].

Although Locke's thought was concentrated on his contemporary questions concerning religion, due to dissents among seventeenth century English Christians, which were already divided into Papists (Catholics) and Protestants (Anglicans, Calvinists, Lutherans etc.), his ideas still allow thinking about ways to be found in order to promote dialogues among different believers, because, in order to live in a global age, the respect for humans is necessary and, indeed, it also means the respect for his beliefs.

5. Some ideas concerning education, according to John Locke

Locke's thought about education, at the first sight, seems to be exclusively an elitist proposal, because he is only interested in gentleman's breeding. His main aforesaid work about education (*Some Thoughts Concerning Education*) is made of his correspondence with one of his friends (Sir Edward Clarke of Chipley, Esquire), a British nobleman to whom Locke wrote letters in order to help him to train his children. Thus, it is very clear that Locke practically thought about how to breed a child born into nobility. However, his educational ideas may be rethought under another angle, if one understands that his ideal of individual is someone whose training is to be able to make him the best possible human being. Thereby, the importance that he attributed to education is unquestionable, because, according to him, due to their education, people are able both to their own improvement and to their own ruin. Therefore, in order to train human beings, education is an activity that deals with both the body and the mind; that is: education is a psychophysical process.

According to the aforesaid quote, Locke is really persuaded concerning the powers of education, which, summarily, consists in teaching body and mind habits to child. Like a psychophysical process, he divides education into two main dimensions; these are:

1. Physical dimension: it refers to body cares; it is also divided into parts like these:

- Hygienic dimension: it consists in teaching habits that may provide a very good bodily health.

- Nutritional dimension: it consists in teaching habits that provide a suitable selection of drinks and food to be consumed.

- Sporting dimension: it consists in teaching habits that, by practicing some kind of sport (for example: swimming), may provide body skills and health improvement, too.

- Manual dimension: it consists in teaching a manual ability, profession, or trade.

2. Psychical dimension: it refers to mind cares; it is also divided into parts like these:

- Behavior dimension: it consists in teaching good manners or etiquette in order to suitably or wisely behave in social relations.

- Intellectual dimension: summarily, it consists in teaching everything knowable; methodically, elementary skills (like reading and writing), foreign and vernacular languages (classical and modern), and scientific disciplines in order to train the mind, intellectually; to inspire good feelings about knowledge, emotionally; to promote self-improvement, personally.

- Civic dimension: it consists in teaching civil laws in order to be aware of citizenship, belonging to social body as a member with both rights and duties.

- Moral dimension: it consists in teaching virtue, that is: intellectual and moral excellence.

- Religious dimension: it consists in teaching things concerning the existence of God (summarily, Absolute and Supreme Being, Author of the Universe, and Giver of All Gifts), as well as everything concerning him (Revelation); moreover, according to Locke, God is the foundation of virtue.

- Playful dimension: it consists in reinforcing the importance of entertainment to teaching and learning process or to affirm the pedagogical worth of games.

Summarily, Locke conceives education like a process that turns mainly around these four aspects, especially concerning gentlemen's training: virtue, wisdom, breeding, and learning. They sum up all the aforesaid dimensions and their subdivisions. In fact, without them, there is no education. Therefore, they are things that every gentleman must desire for himself, as well as for his descendants, because they must be part of his legacy: "That which every gentleman (that takes any care of his education) desires for his son, besides the estate he leaves him, is contained (I suppose) in these four things: *virtue, wisdom, breeding*, and *learning*" [18].

6. Conclusion

Although Locke belongs to a different age from the present one, he treated questions that, nowadays, are still present and he did very well, because his arguments are still worthy. Therefore, Locke's thought is very useful to think about how to find ways in order to make a global age. His epistemological ideas suggest that several kinds of knowledge should be respected, because experience can be made in several ways; it means that: if, on one side, Locke supports that experience is the only way to achieve knowledge, on the other side, however, it does not mean that everybody follows or must follow the same way to reach their knowledge. His political and social ideas offer a lawful way to set a society based on freedom and equality among its members; surely, they must not be overlooked, if one understands that democracy is the best possible way of living in a commonwealth. His religious ideas are a very powerful antidote against the poison of intolerance, because his demonstration reveals that choosing a religion should only be a matter of persuasion, not of imposition. His educational ideas reinforce the importance of conceiving education like a human psychophysical activity in order to breed both body and mind, because it is just a way to arrive to the best human being possible, whose example is a gentleman.

The global age is not only a presence or a reality, yet; it is an ideality or a project, too. Thus, there are many challenges and hindrances to be overcome in order to include the most possible part of people around the world. Surely, it is a time of rethinking many values, such as: educational, intellectual, moral, political, and religious ones, because the present times are also times of crisis or lack of hopes, due to several factors, such as: increase of poverty, ascension of terrorism and, environmental aggression. Thereby, the temptation to fall into dogmatism is very great. In a global age, it is imperative to combat any kind of dogmatism, educationally, epistemologically, politically, and religiously, because it is the root of lack of toleration, violence, and every kind of physical and moral aggression. Education, knowledge, politics, and religion are questions that must not be overlooked, because they are ways for citizens to be aware of

the present worldwide situation and thus they may work on the necessary changes in order to establish values that can promote human development, without disrespect for people and environment: that is why, nowadays, John Locke's ideas are still so important to be revisited.

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Post-industrial Virtue Epistemology on Globalized Games and Robotics

Theodore Kabouridis

Abstract

With the development of personalized and globalized technologies, a discussion regarding how and why virtue epistemology should be an essential part of post-industrial ethical analysis on augmented technologies and use of robotics in the global age becomes crucial. These globalized technologies in the form of either game apps (i.e., *Pokémon Go*) or robotics like drones become through the Internet multimedia a structural part of planetary digitalization. While this development takes place, traditional virtue epistemology responds insufficiently to the devitalization of knowledge regarding manners (*savoir vivre*) and ways (*savoir faire*) of practicing and the need to respond to the sudden expansion of augmented games and drone use with personal and social intellect, responsibility, and consequently safety. The chapter intends to discuss this analysis in order to argue that a postindustrial epistemic reconfiguration of digital ethics is necessary, since augmented reality games and robotics are taking the form of massive trends for adults and nonadults, while for the first time, digital gaming and robot entertainment exceed the limits of the personal space and the virtual mode of the screen, moving out into the public realm, where reality is mixed with virtuality and human environment with unmanned robots.

Keywords: postindustrial, virtue epistemology, augmented reality, drones, globalized games

1. Introduction

Augmented reality (AR) digital games like *Pokémon Go* and robotic entertainment like drones redefine the ethical character of gaming in a public scale, since they become instantly popular and globalized by the IoT. In this sense and in terms of technology and entertainment,

being global means being digital [1], since this "game globalization" develops independently from the politics of globality, and consequently one can estimate that these practices will be enhanced, developing the future of digital entertainment. Hence, the question that the chapter wishes to answer is whether it is possible to apply a virtue epistemology in the global expansion of digital games and robotic entertainment, in order to redefine the knowledge conditions of *savoir vivre* and *savoir faire* in terms of their use that will be practically depicted in the minimization of their personal and social side effects.

2. Expansion of augmented technologies and the epistemic gap between VR and empirical conduct

Pokémon Go [45] and relevant augmented technologies like *Ingress* [45] or *Zombies Run* [46] bring for the first time an active intersection between virtuality and the real world, by practicing a virtual order in an empirical scale. As "Augmented," we define the technological reality where "virtual content is overlaid into a user's perspective of the world" [2]. During the summer of 2016, *Pokémon Go* gained a massive popularity in a world scale that showed everyone what does the term "globalized game" means. This sense of globalization reached a new level of authenticity that was different from the first arcade globalized video games like *Pac-Man* [47] and *Space-Invaders* [48]. Whereas the latter have been developed gradually from one country to the other within a decade, *Pokémon Go* has reached a level of global acceptance only within a month. This rapid expansion of augmented games is to a large extent the result of the progression of IoT and the digital transformation of video game industry's way of thinking from local to global.

The credits for a free-to-play game whose purpose is to locate and capture virtual creatures along with the fact that *Pokémon Go* "has been suggested to improve public health by promoting physical activity" [3] made it instantly popular. The "health benefit" idea that many augmented mobile technologies offer is a decisive factor that differentiates their form of virtuality from traditional virtual reality (VR) game, which is static, leading to body inactivity: "now that many adults have a powerful and Internet-connected device always within reach in their pocket or handbag, the smartphone has become the ideal platform for short, sporadic, and flexible moments of video play" [4]. This shift from virtual passivity to virtual activity plays a central role in enhancing the user but at the same time brings for the first time in human history a practical and daily convergence and intersection between virtual and real environment. The *Pokémon Go* player chases virtual creatures in a real environment while at the same time other (nonvirtual) practices take place. The practice of the game, when it goes public, creates factual dangers not only for the player of the game but also for others, becoming thus a functional problem of ethical conduct (*savoir vivre*: knowledge of manners and *savoir-faire*: knowledge of ways).

Hence, the main advantage of augmented reality games can be transformed, because of a lack of ethical conduct into their main disadvantage. By ethical conduct, one defines a set of rules, in the form of an ethical code, that will promote the values of the game (i.e., virtual values of the game), with respect to the already existing values (i.e., physical and social reality

values). In this section, I intend to show by using both actual and theoretical cases the side effects of the aforementioned intercrossing between virtuality and reality that outdoor use of augmented games may cause [5]. With 15,000,000 players behaving virtually in a real environment worldwide, the number of car accidents in the USA reached 113,993 incidents in the first 10 days of its use, which were caused either by drivers' or by pedestrians' distraction [6]. Virtual distraction provided the chance for many robberies to succeed since the players/victims have been vulnerable to physical attacks. Furthermore, an increase has been noticed in trespassing on railway lines and in the road [6]. In addition to these, a recent research showed that "More than a quarter of players reported being likely or very likely to play the game while driving (27%), biking (43%), walking (without paying attention; 32%), and sacrificing sleep to play greater amounts of the game (38%)" [7].

Theoretically, the catalog of safety problems can be continued with the addition of all the possible incidents of disarrangements in daily life activities from walking to shopping disturbances and from riding a bike to drinking a coffee, but what is more important is that virtual distraction from the dangers of physical reality might lead even to potential kidnapping [8]. Even though the diversity of dangers can be endless from a quantitative point of view, in terms of their quality one can conclude that their character can be physical, legal, psychological, and cognitive and that "mobile and mobile-augmented reality applications can promote distraction" [9], since Pokémon Go "is the first mass market app that fully transcends the virtual, the spatial, the social, and the physical" [10].

The epistemological inquiry underlines that in these activities a person behaves in an empirical environment, with real dangers and contingencies, in a virtual manner, establishing thus (a) an epistemological discontinuity (from physical to virtual) and (b) as a consequence of (a), an ethical disorientation [11]. According to Deleuze's analysis of the relation between the virtual and the actual, these two modes of being create "a form of circuit" [12], where "the actual is the complement or the product, the object of actualization, which has nothing but the virtual as its subject" [12]. Hence, from an ontological perspective the virtual appears as a modal reality of the actual, but by describing the problems of virtual distraction in a physical environment one refers to two different understandings of actuality.

In the player's hybrid actuality, the physical environment is a fact that is contiguous to the fact of the quest of a virtual creature, while for the non-players physical environment is a fact that is contiguous in their personal activities in a public space. However, there is a crucial difference among the players and the non-players which is that for the non-players there is nothing apart from themselves to distract them, whereas for the player there is a virtual component that (a) distraction is part of the game since they chase a virtual creature, (b) that this virtual creature is something other than themselves, and (c) that the responding activity of the software during the game is totally unconnected from the other facts of the physical environment.

Thus, even if both groups perform something practical, the group of players develops a behavior that after a certain point disconnects it from the environment it belongs both physically and socially since "they expand the game outside the traditional game space (the board or the screen) by merging physical and digital spaces" [13]. This is what causes an epistemological discontinuity from physical to virtual, not because the game is not actual but because in order for the game

to proceed, a part of it (Pokémon's "behavior") remains unpredictable and thus totally disconnected from the physical environment of the public space. On that account, for the first time in human history we are dealing with a software game that energetically drives the player's attention away from its physical and public environment, without any recognition of the changes or the possible dangers of the latter. This lack of detection can be verified not only in extreme cases like an earthquake, where the Pokémon will hide in the debris, but it becomes even more obvious through the daily frustration that it applies in human interaction leading often to accidents, serious or minors, and it is at this point where the epistemological discontinuity transforms into ethical disorientation, that is, a social mismanagement of the ethics of public sphere.

Ethical disorientation through augmented video games is not the product of a different understanding of ethics, nor is it part of an "augmenting situationist movement" revival through a downloadable alternative as some have discussed about AR games. What develops intrinsically between the game's players and the non-players is a virtue conflict. A virtue collision is between playing the game sufficiently in order to win using virtual manners in public on the one hand and be absorbed by daily life routine public ethics of *savoir vivre* and *savoir faire* on the other. What appears theoretically as an epistemological discontinuity continues practically as ethical disorientation in human interaction but ends up as a conflict between different virtue motives: "With *Pokémon Go*, locative game use behavior becomes a public event, a matter for public regulation. It becomes so recognizable as a reason to congregate in urban public places that it may become a resource for political demonstrations. In short, while most of the game-related mobility observable with *Pokémon Go* has already been observed before, the sheer commercial scale of the game turns such mobile behavior into a new kind of issue" [14]. Consequently, the most crucial aspect one examines in relation with global AR video games opens up as a problematization of virtue epistemology.

This becomes unavoidable after a certain point since the rapid expansion of technological evolution causes a virtual rearrangement of physical life as we knew it. Biomechanical structures, which are extensions of physical movements through mechanics, are substituted by intermediational processes, which are representational replications of reality through screens, where the virtual and the physical, that is, the digital and the analog, functionally intercross one another leading among other things to conversions of virtue motives that likewise ethically intercross between virtual and physical. Augmented reality video games are the first technologies that manage to globalize this intersection between physical and virtual since "AR enjoys clear advantages in comparison to the traditional VR. One of the key advantages gained by AR is having a better sense and interaction of reality whereas it lays emphasis on the organic integration of virtual environment and the real world" [15].

This means that in order to further explore these technological and ethical rearrangements, virtue ethics and virtue epistemology have to update their analytical character and involve further into subjects that deal with hypermodern virtue crossing between physical ethics and its already-established *savoir vivre* and *savoir faire,* and virtual or augmented games ethics— "games that elicit physical activity have been called Active Video Games (AVG)" [16]—as well as with their apparent weakness to connect their virtue motives to physical environment.

The very fact that pushes someone to distinguish between physical and virtual ethics is a consequence of epistemological inadequacy to formulate forms of "augmented" ethics that would sufficiently correspond in a problematization upon a technology that "bridges the gap between the real and the virtual in a seamless way" [17]. It is important in order to proceed epistemologically to understand the nature of this epistemic gap, between physical and virtual or augmented reality. I will use as a basis of analysis a classical—in terms of ontological significance—and still current distinction between physical and social reality by John Searle. According to Searle, there is physical reality whose facts are measured by mathematical, physical, chemical, and biological factors, and there is social reality that even if arbitrary—and by arbitrary Searle means constructed—it is constituted by social inventions that become factual through collective intentionality which represents for Searle "a biologically primitive phenomenon that cannot be reduced to or eliminated in favor of something else" [18] like individual intention. Collective intentionality is based on social consent and the latter includes both ethical and virtue standards in relation to functional and consequently technological uses.

In other words, all forms of technology emerge in our daily life with the objective of becoming functional and massively useful directly or indirectly. However, their functional character presumes a transformation or an adjustment of our collective intentionality by approving and expanding their use practically. According to many, it "is laudable that Pokémon Go encourages players to become more active in walking and running whilst playing the game, which undeniably will contribute to the need for regular cardiovascular exercise in the fight against obesity. It also promotes exploring local areas and points of interest, which should be encouraged" [19]. This practical use either promotes new forms of ethics and virtues that correspond to the already existed, creating thus social consent, or collides with the established ethics and daily behavioral virtues, that is, *savoir vivre* and *savoir faire*, causing a turn of collective intentionality away from it. Some examples of innovative technologies that failed to be bridged with the ethical standards of their time are Google glasses, nuclear weapons, e-books, virtual reality, or driverless cars. All these technologies have failed to be massively accepted for several reasons and incompatibilities that were cognitive, practical, or even psychological, but in every case, they failed to create an ethological bridge with previous practices and forms of understanding.

Hence, the epistemic gap is the consequence produced by any cognitive act that becomes technologically operative, and while it transforms our empirical and perceptual aptitude, it manifests itself by its difficulty to bridge technological operation to the ethology of the present in order to become functional. Technological inventions are artifacts by materials and scientific applications of physical reality which expand the latter, but in order to be functional they have to be absorbed practically by collective intentionality. Augmented reality video games are no exception from this ground, but by evolving in an interactive, public, and most importantly global manner, which at the same time diffuses augmented reality into fields such as education, professional training, and research activities, it is meaningful to seek through a hypermodern virtue epistemology for those elements that will couple physical and virtual components of an augmented ethos.

3. Drone robotics, uncontrolled aviation, and virtue ethics

Drone robotics is an example of microtechnology machines that also for the first time transforms social and ethical perception of airspace environment. Similarly with the case of AR video games, drone practicing especially through private ownership might have side effects that can end up highly problematic in terms of privacy violations both in public and in a domestic environment through airspace. The drone fear regarding their private use affects the relation between civil airspace and ethics of everyday life to the extent that (a) civil airspace has not been occupied before by unmanned robots and (b) human ethics are based on biological factors of communication, perception, behaviors, and reactions that exclude aerial concentration.

The historical and practical codification of human terrestrially based ethical standards is expressed through the use of a corresponding *savoir vivre* and *savoir faire*, that is, knowledge of the codes of behavioral and communicational virtues that create a hierarchical but practical state, while avoiding chaos and social misconceptions in everyday life. Both knowledge of *vivre* (living in the existential sense) and knowledge of *faire* (social skills) are not simply codes of polite manners and aesthetic formations, which is their usual, however, superficial account, but they are active statements of order and functionality that use as their basis capacities of virtue. My argument will attempt to demonstrate that their virtue capacity is not only useful but also significant in a world that rapidly changes, and where social complexities multiply as new forms of activities and thus ethical frictions constantly emerge. This argument becomes evident when applied in the use of new technologies that is under private ownership and used in public, like micro-robotics and specifically drone robotics.

Through the IoT, we experience an interface between physical and data reality where "drones represent a part of these "things" that collect, store and process large quantities of data that are then here to be acted upon" [20]. DIYers and hobbyists become increasingly fascinated with drones that become more and more affordable for personal use globally: "A generation is growing up with robotics as a part of its engineering DNA. It is only a matter of time before that generation shocks us with what it can do—and how cheaply" [21]. Notwithstanding, according to a recent US public poll "forty-two percent went as far as to oppose private ownership of drones, suggesting they prefer restricting them to officials or experts trained in safe operation" [22]. In addition to that "64 percent said they would not want their neighbor to have a drone" [22]. The reasons behind these hesitations are fear of snooping, violation of privacy, and anxiety regarding monitoring. Since private drone use is legal, and since it is impossible to recognize and distinguish whether a flying drone belongs to a company or to a citizen, a new era concerning the above ethical fears has begun.

It is inescapable thus that drone users, both private and companies, will blend into civil airspace, with entertainment and commercial motives, respectively, and that without a previous code of ethical management, drone using will definitely confirm the ethical uneasiness of the public. First and foremost, drone offers to the user the power of invisible presence, that is, the ability to record and collect parts of physical reality from distance without being seen but through a "subjectless machine" [23]. Thereupon, if we consider that there is a behavioral problem in a person that stumbles on others or in objects, while messaging in a mobile

phone, and if we conclude that there is something alarming when a person endangers his/her existence while chasing a nonexistent virtual creature, then to expect violations of privacy by drone civil use is a concomitant event since "drones are able to fly autonomously in different altitudes and they are usually equipped with sensors to monitor the environment and communication units to exchange data with other drones or central stations" [24]. The common element in those three cases is that they all appear as massive technological trends that pervade anthropologically in daily culture.

It is obviously the beginning of a post-industrial and global form of entertainment that differs a lot from the globalization of games such as skateboarding, rollers, or anything else that operates as an analog mechanism within the perceptional and restrictive limits of physical reality. Whereas in the case of AR games, one can object that during the game the fault about whatever may happen is strictly perceptional, hence the technology itself is secure, when it comes to drones, a recent research—which is the world's first with regard to accidents with drones—shows that there are technological defects that lead to operational misadventures: "Recently published in the journal *Aerospace*, the study found that in most cases, broken communications links between the pilot and the RPAS were the cause of the incident, leading the researchers to call for the introduction of commercial aircraft-type regulations to govern the communications systems" [25]. The study opens the question of responsibility in case of an accident regarding "Who (or what) is responsible? The drone itself? The designer of the drone? The officer who gave the order to deploy it? The commander in chief? Similar questions spring to mind in almost every application of autonomous robots we care to think of" [26].

While the study reveals that drone industry has to promote even more sufficient ways for solving safety and operational problems, the law regulation for drone use differs from one country to the other, whereas in many countries the regulations are inexplicit and in some others they do not even exist. Technology and experimentation are historically synonymous, and the myth of Daedalus and Icarus is an ancient narrative that appears as an account of a pioneering technology that ends up in a tragedy. The account suggests that independently of the operational deficiencies in any technology, it is always the human factor that supervises and ensures its safe use. In the case of drones, apart from the legal incongruity and the operational problems one should also consider their further booming through the convergence between their price decline and the growing fascination for a fast-developing technology that corresponds in a very wide category of usages beyond entertainment, from photography and mapping, to survey and cargo systems.

The lack of a general and common post-industrial legislation shows for once more that theory comes after practice and thus always behind time, but the most important thing displayed is again the lack of a universal attitude that exposes the epistemic gap between human terrestrial biology and the occupation of civil airspace by drones. Since human terrestriality is common and since civil airspace relates to it under the same biological limitations globally, then the legislation for drones ought and should be generalized and become a post-industrial ethotechnological matter-of-course, that is, a *savoir vivre* and a *savoir faire* for robotics. But in order for this to happen, a virtue epistemology should prepare the basis for the virtues upon which legislation will further develop into laws since virtue "is a synthesis in which the law loses its universality and the subject its particularity" [27].

In other words, virtue is to be understood in the modern world as the "synthesis of personal character and the objective norms" [28]. Because when a legislation does not come under a set of virtues that connect intrinsically virtue and technology, then it progresses as prohibition or conformity that demands obedience or deference to a set of normative rules that as "technical" as they may be by setting different measures of distance from domestic areas from drones violations; they will never be able to reach neither the speed nor the magnetism that new entertainment technologies achieve either by mixing different modes of reality (respatialization through AR) or by actualizing enterprises that humans are biologically unequipped to produce by their own means (respatialization through unmanned aerial vehicle (UAV)).

Consequently, it follows that the virtues one seeks to promote for a post-industrial ethos should be able to connect the epistemic gap between historicity and functionality of virtues. In other words, one has to employ classical elements of virtuosity (citizen virtues imposed by society), and adjust them to modern or civic virtues (individual virtues exposed by the self), towards the practical needs of hypermodern freedom, where individuals create environments by the technical means of their time, like VR and AR, and understand their freedom by and through these technical objects (virtues of civic individuality disclosed in a digitally respatialized environment: technoviduality). The latter explains the anthropological and cultural gap between an era where freedom was solely an event of dialogue and face-to-face communication from the current annexation of face-to-screen discursive reception and transmission.

Technovidual becomes a receiver of otherness and a presenter of itself through different media embodiments and the progressive globalization of IoT. Within post-industrial ethics, individuals acquire the opportunity (especially the younger generations) of receiving the social realm neither through imposition nor solely by physical communication but through different interconnected devices. This is why it is essential for the individual to understand these personalized mediums as foundational part of its current conditions of freedom. Machine becomes the new fellow being because the human fellow being is present as a respatialized extension of the machine, not only technically, as it was the case since the industrial revolution, but post-industrially as a person. But even in their political struggles for freedom, for example, the Arabic spring, people consider for the first time unarmed mobile machines to be their informational "comrades."

From an epistemological point of view, humanity is passing from a transformative stage of its technical and thus environmental and communicational status into a new one where human presence becomes an issue of respatialization through technicity, but to the extent that this is a fact, then it follows that virtues, as part of presence, become also an object of respatialization processes. On that account, one may begin to acknowledge some basic public virtues as elements that civic technological use either in the case of AR or in the case of robotics can and should attempt to engage. A possible employment of a virtue like technological *phronēsis* (prudence), composed by supplementary character traits like technical *euboulia* (deliberation) or *sunesis* (sagacity), and intellectual skills like technical *deinotes* (cleverness) and technical *gnomê* (judgment), would be beneficial not only in terms of a dialogue between virtue epistemology and technological ethics but most importantly in the understanding of practicing these technologies with social responsibility and eagerness. In other words, a postindustrial virtue analogy would connect existence (*vivre*) and sociality (*faire*) with the global development of digital culture and digital anthropology.

4. Promoting virtue through epistemological analysis

To the extent that ethical problems become practical as I have shown in Sections 1 and 2, and based on the fact that augmented technologies and robotic engineering as globalized trends in entertainment will inevitably continue to develop, virtue epistemology has to address the problematic character of the discussed practices by focusing between the cognitive capabilities of the augmented gamer or the drone user (reliabilist approach) and their corresponding intellectual traits (responsibilist approach). In this section, I develop an argument that will incorporate elements both of the reliabilist and of the responsibilist approach in order to show that both of them are equally important and interdependent for the development of a post-industrial virtue approach toward the public use of AR and robotic technologies.

The distinction separating the reliabilist and the responsibilist approach consists in two different classes of cognitive and intellectual traits correspondingly that provide a person with the ability to qualify intellectually and/or as a character: "'Virtue responsibilists' conceive of intellectual virtues as the intellectual counterpart of moral virtues. These include traits like fairmindedness, open-mindedness, intellectual carefulness, intellectual courage and the like. 'Virtue reliabilists' conceive of intellectual virtues as any reliable or truth-conducive quality of a person. They cite as paradigm cases of intellectual virtue certain cognitive faculties or abilities like vision, memory, introspection and reason" [29]. I further argue by using four Aristotelian "secondary" virtues like *euboulia* (deliberation), *sunesis* (sagacity), *deinotis* (cleverness), *and gnomê* (judgment) that it is possible to formulate a postindustrial *phronēsis* whose target would be to

a. bridge the epistemic gap between spatialized and respatialized realities in terms of social responsibility and public rights (e.g., physical and virtual in the case of AR, or terrestrial and aerial in the case of drones);

b. provide the ground for a psychologically safe and easy-going approach of practicing technological entertainment;

c. ensure responsibility without minimizing the skill competition and the enthusiasm for these technologies; and

d. refresh and regenerate the importance of *savoir vivre* and *faire* in the digital era as a guarantee of technical intellect based on virtue (both moral and cognitive).

Since we deal with problems that are first and foremost practical and it is through their social practicability that they become ethical, and since the reasons of our inquiry deal with public and consequently civic virtues, the aim of the chapter is not to isolate the knowledge of the good from practicing the good, which corresponds to the Aristotelian notion that "the science of the human good is politics" [30] and in particular social policy regarding public games and robotics. However, a postindustrial social policy of this kind should not be framed upon a plan that connects policy with the exercise of a corresponding law wherever the latter exists or whatever it may concern, but with the exercise of policy based on virtues. The main problem with law or legal pressure for safety reasons regarding personalized technologies and micro-/nanorobotics like AR games and drones is that their mobility along with their

increasing effectiveness regarding respatialization makes legal intervention a complicated and insufficient tool, from both a regulative and an operational point of view, which as experience from other cases shows, when it cannot intervene drastically, it becomes more disciplinarian and prohibitive.

According to Bent Flyvbjerg, it is possible to connect virtues such as *phronēsis* to contemporary social policies, since "Aristotle saw not only as the necessary basis for social and political inquiry, but as the most important of the intellectual virtues. *Phronēsis* is most important because it is that activity by which instrumental rationality is balanced by value-rationality, and because such balancing is crucial to the sustained happiness of the citizens in any society" [31]. *Phronēsis* in a post-industrial context is the virtue that is able to intellectually connect the epistemic gap caused by technological inventions to the problems caused by the users of these technologies, that is, between *episteme* and *techne*. In particular, by using four supplementary virtues, like *euboulia* (deliberation), *sunesis* (sagacity), *deinotis* (cleverness), and *gnomê* (judgment), I will explain why they can sufficiently correlate with the four targeted propositions of a postindustrial virtue epistemology. The first two of these intellectual virtues can be described as assimilative in their characteristics, whereas the other two as enterprising. By assimilative, I mean that character-trait virtues like deliberation and sagacity have absorptive capacities that contribute in the closing of the gap between *episteme* and *techne,* whereas by enterprising, intellectual virtues like cleverness and judgment innovate these new fields to move beyond the gap by organizing the ways through which these practices will remain exciting while prudent and sensational while safe.

Both deliberation and sagacity are virtues that inherently act as filters in that they process thinking in order for someone to arrive at a conclusion or take a decision: "Aristotle thinks that deliberation is the principal manifestation of the practical effectiveness of intelligence" [32]. Deliberation (*euboulia*) in the context of a post-industrial *phronēsis regarding* AR games and drone use in public means to think, and carefully decide about the ways through which a technological entertainment practice may or may not cause discontinuities in the function of public life. Public function is based on a set of globalized social rules, which are empirically tested and verified as appropriate and legitimate, and they include safety of the others and ourselves, respect of their presence and activities, and reciprocal understanding of what needs to be done in order for the others to carry out whatever they are doing.

The negative effect of the industrial revolution was that for economic reasons equipment and machines brought in a person's everyday life phenomena like noise and pollution. The danger of postindustrial and personalized media is for a person the loss of touch with public sense in favor of his/her own entertainment and fall into escapism: "Pokémon Go is a new distraction for drivers and pedestrians, and safety messages are scarce. Delayed reaction to mobile phone distractions has hampered public safety" [33] Deliberation is a character trait for anticipating these consequences between public rights and technological rights.

Social rules of public life are not only empirically tested but through their diachronic use they acquire their own historicity, and through that, public life introduces itself in our mind as a sheltered sphere of multiple activities where one can feel safe and respectable, independently of race, gender, taste of fashion, or social class. This historicity (of safety and respect), which is

based on public performances of social behavior, connects the existential to the public sphere in the most rhythmic manner possible and through that it achieves this transition with the less possible production of anxiety. Hence, sagacity (*sunesis*) through self-control represents a form of perceptiveness that would be able to understand the technical discontinuities caused by the epistemic gap between physical and virtual, terrestrial and aerial, and apprehend the anxious results this gap can motivate to a number of people that may bewilder or feel alienated by a senseless exercise of technological entertainment practices in public. Sagacity secures psychology of the public life from such events since it guarantees that existential and psychological factors are equally important with external social rules of behavior.

Cleverness (*deinotis*) is the first of the two enterprising intellectual skills and its role is to produce ways that based on the two previous trait virtues can ensure that both robotic and AR entertainment will be further developed and expanded. Cleverness with its inventive ethos is able to create new forms of crossroads between physical and virtual, terrestrial and aerial technologies, which will introduce this increasingly innovative and global practice through the public sphere via multiple interplays of activities and related themes in order to develop and organize the intensified interest for these technologies. It is crucial to understand cleverness as an extended continuation of the two aforementioned character virtues (deliberation and sagacity), since without them, cleverness regarding these practices can easily turn through marketwise processes into merchandized services that by "exploiting" the epistemic gap and its social consequences create specialized environments either for AR games or for drone flights: "If a company decides to use *Pokémon Go* for developing a layer of commercially relevant interests, there is little in terms of conventional laws and regulations to stop them. This erodes the commons, and instrumentalizes for private profit a space originally open and regulated for the benefit of the many" [34]. When intellectual virtues like cleverness grow without character virtues that would assimilate the collision between different virtue motives (e.g., physical motive vs. virtual motive) as it has been discussed in the first section, then strict laws and merchant thinking are taking over, the first the safety of the social regularity and the second the "sheltered" defense of entertainment practices through the creation of corresponding products and services.

Finally, judgment (*gnomê*) represents the completion of *phronēsis*, since it is in judgment where the accuracy or the weakness of a behavioral performance approximates or diverges from *phronetic* virtue. Through judgment, the three previous character traits and skills are exposing themselves as *phronetic* or *aphronetic*. The incidents, accidents, and concerns of the first two sections regarding AR technologies (i.e., Pokémon Go) and drone robotics can be described as the result of *aphronetic*, that is, imprudent approaches of technological uses in the public sphere. But what *aphronetic* means in practice is that one or more of the aforementioned traits or skills has not been adequately preformed or included in the phronetic process. Hence, even if there is a virtue motive in every technological performance that got in conflict with other (physical) motives in the social sphere, technical *phronēsis* has not been achieved in all these problematic cases: "Skills are teleological in that they have a goal or a purpose and the general principles of solving the problem of attaining goals are constituted as phronesis. Phronesis itself is not a skill, for it has no logos of its own. Rather, it is embodied within the logos of each skill" [35]. Hence, post-industrial *phronēsis* should be able, unlike traditional virtue epistemology

which is based entirely upon hypothetical arguments to clarify through technological praxis, that character traits like deliberation and sagacity facilitate intellectual skills in order for them to transform and become *phronēsis*: "Longterm, rigorously designed studies should look at mechanisms of effective Internet-based interventions such as cooperation, competition, nostalgia, intermittent reinforcement, sense of control, and augmented reality" [36]. At the same time, character traits are also unable to distinguish as *phronēsis* by themselves unless they intermingle with intellectual skills like cleverness and judgment.

Conclusively, the suggestion of this model for a post-industrial *phronēsis* used two different forms of virtue elements, the first two were character-trait virtues and the second intellectual skills. I have described the first two as assimilative to the extent that they both include elements of perceptiveness of an environment which in this case is composed by social, psychological, and historical factors of behavior that needed to be understood by the appropriate character traits like deliberation and sagacity. This understanding, executed by these character traits, composes a field of knowledge, which is practical and social, and since the performances of both AR games and drones are public, knowing the field and the conditions that compose it is a prerequisite of the game rules. Therefore, public sphere and its corresponding *savoir vivre and faire* social rules should be seen as an essential part of the game/flight entertainment. But by being part of these processes and in order to be a virtuous player or pilot means to have knowledge of these rules and respond to this knowledge appropriately. When the latter occurs in technological processes of respatialization, post-industrial *phronēsis* takes place.

5. Technological epistemology and postindustrial intellect

By arguing epistemically about the ethical basis of "know how to play" and "know how to use," virtue epistemology not only introduces present and future generations into an epistemic ethics of technological responsibility in a field of unexpected dangers and side effects but also updates our epistemological understanding by redefining the boundaries across which socially and ethically—but most important practically and thus functionally—philosophical inquiry can draw the line between technological character and intellect liability on the one hand and technological irresponsibility and senselessness on the other (i.e., the systematic repetition of a mistaken *savoir vivre* and a mistaken *savoir faire*). Technology updates the conditions of living [37] and therefore the conditions of knowing and accordingly acting. Based on this fact, virtue epistemology is necessary, in order to create the epistemic basis of ethical conduct between technological order and conditions of living.

The argument of the third section attempted a synthesis of four supplementary virtues in Aristotle that I have used, by distinguishing them into character traits and intellectual traits. The argument suggested that each group of traits is unable by itself and solely by itself to formulate the virtue of *phronēsis*, but instead in order for this to be achieved, the two groups should associate in order for the assimilative traits to absorb the gap between physical and technological respatialization with responsibility, whereas the enterprising to achieve skill competition and develop further the technical characteristics of these new global

entertainments. This analysis, persuasively or not, has targeted to present a new possibility where virtues and postindustrial intellect can and should interweave in a world that does not go global and digital only materially but from within, where within means socially and anthropologically.

In such an internal transformation, daily and historical human phenomena and concepts such as friendship, workplace, love, society, university, and even the concept of truth are under alteration. Since all these concepts are related with one way or another with human intellect, it becomes necessary to examine what are the consequences of a post-industrial intellect that acts imprudently with (nano)technological strains that move from virtuality to reality and from terrestrial to aerial functions. In specific, one needs to consider how this intellect can be developed if virtue adoption fails: "The clear implication is that immersion in a vulgar, degrading mass culture cannot have any such effect. If anything, it is likely to have a brutal-izing effect, making one more mean-spirited, self-indulgent, less open to loftier feelings, and hence less given to the pursuit of virtue" [38].

According to Bernard Stiegler: "To live in the extremely complex milieus that deploy this industrial and planetary technical system, a system capable of unleashing colossal power at any instant, requires of the people traversing them that they maintain a blind trust" [39]. There are at least two crucial factors that one has to underline in order to penetrate into a very possible dystopic scenario: the first one is the miniaturization of technicity via nanotechnol-ogy and the second is the liquidation of ethics [39], through narcissism that expresses itself as total ignorance of applied virtues (stupidity) or in an even worse scenario as a disbelief in the value of virtues (cynicism).

Post-industrial intellect suffers first and foremost ethically and then intellectually, to the extent that it fails to synthesize and then follow and perform in a virtuous order. Technological miniaturization of personalized technologies on the one hand and the globalization of narcis-sism through videographic entertainment on the other disregard when they do not flirt with phenomena of stupidity, whereas they silently approve cynicism as a cultural extension and a necessary evil of a competitive lifestyle: "The technology to produce a destructive nano-bot seems considerably easier to develop than the technology to create an effective defense against such an attack (a global nanotech immune system, an "active shield". It is therefore likely that there will be a period of vulnerability during which this technology must be pre-vented from coming into the wrong hands. Yet the technology could prove hard to regulate, since it does not require rare radioactive isotopes or large, easily identifiable manufacturing plants, as does production of nuclear weapons" [40]. Both Bostrom and Stiegler refer to dan-gers, the first by highlighting miniaturization and the second narcissistic cynicism and stupid-ity. The first analysis refers to long-scale effects of an imprudent performance and the second to a short-scale daily basis behavior based on the lack of *savoir vivre* and *faire*.

Technical prudence and technological education go hand in hand and it is obvious that the late twentieth century's educational systems did not manage to supervise what was to become the twenty-first century cultural addiction, screengazing: the cultural phenomenon where com-munication, observation, and human interaction are substituted by the digital videographic alphabet of Youtube and Facebook, "where most people are independently staring at their own

individual screens in parks" [41]. Repetitive senselessness regarding technological misuse, especially in the form of entertainment, that expresses itself intellectually either as stupidity or as cynicism represents the mental consequences of the screengaze phenomenon: "Screens are evolving at a speed that dwarfs the ability of the research community's ability to follow their deleterious effects. Public health researchers, practitioners, and policy makers are left with two options: admit failure, or strive for adaptability when messaging to the public" [42]. Apart from that, there are biological reasons like "the limitation of our observation capacities to only one level at a time" [43], which need to be stretched as part of a postindustrial virtue epistemology that can and should be developed further philosophically and incorporated in educational systems: "With the inevitable future growth in software that bridges the virtual world with the real world, guidelines to prevent potential adverse consequences should be arranged" [44].

6. Conclusions

The discussion about the possibilities of a post-industrial *phronēsis*, which is based on a technical prudence, composed by supplementary traits and skills concerns the present and the future use of daily personalized technologies in public space. The basic argument of the chapter was that AR games and the use of robotics in public while globalizing the local create objective dangers that emanate from processes of respatialization. In AR games, respatialization is taking the form of an interplay between virtual and actual, whereas in drones between terrestrial and aerial occupation and movement. That causes ethical and social consequences as a result of an epistemic gap, between physical spatialization and technical respatialization. The main difference from older forms of respatialization (cinema and airplane) lies in the representational and ontological intersection (AR games), and private microtechnologies flights. Since both of them become digitally personalized, then the main argument of the chapter was that an ethical approach should be based upon a connection of virtue epistemology with post-industrial use of these technologies. In other words, that there must be a set of virtues that would correspond to the four basic components that would ensure the transition of a savoir *vivre* and a savoir *faire*, from physical to digital devices use and public behavior.

The latter would consist of (a) the bridging of social responsibility with public rights, (b) setting up the ground through perceptiveness of public psychological factors such as anxiety caused by these uses, (c) ensuring responsibility while increasing skill competition and enthusiasm, and (d) setting and evaluating in practice the formation of a technical intellect from a moral and cognitive perspective. The argument proposed four components, two of which are assimilative character traits, like deliberation and sagacity, whereas the other two are enterprising intellectual skills like cleverness and judgment. The argument suggested that it is only through their mutual incorporation that a post-industrial *phronēsis* becomes achievable, since neither character traits nor intellectual skills are adequate for the completion of a phronetic process by themselves.

Finally, the chapter presented the view that imprudent or aphronetic performance multiplies the danger caused by miniaturization of devices leading to great catastrophes (long-scale effects of imprudent performances), or by narcissistic cynicism and stupidity leading to an insecure and disturbed public life by inappropriate practicing.

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This book consists of seven chapters containing multiple questions of the global socially epistemological situation in science and higher education. Despite the progress of techno-sciences, we are facing blind flaws in leading systems of knowledge and perception. The global era, in a paradox way, connects the new knowledge of economics, postpolitics, postdemocracy, and biopolitical regulation of live and unpresentable forms of the global geo-located violence. Techno-optimism and techno-dictatorship in the twenty-first century coincide with the ideology of market, biopolitics of mandatory satisfaction, religious revivalism, and collapse of higher education. In order for sciences to recover, it is necessary to make a globally epistemological and moral turn toward the truth. The book shows that, when joint desires of the new economics of knowledge and technology erase epistemology (in a way to assign definitions of knowledge and rules and practices of the public usage of the mind), then the time for epistemology is on its way.

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