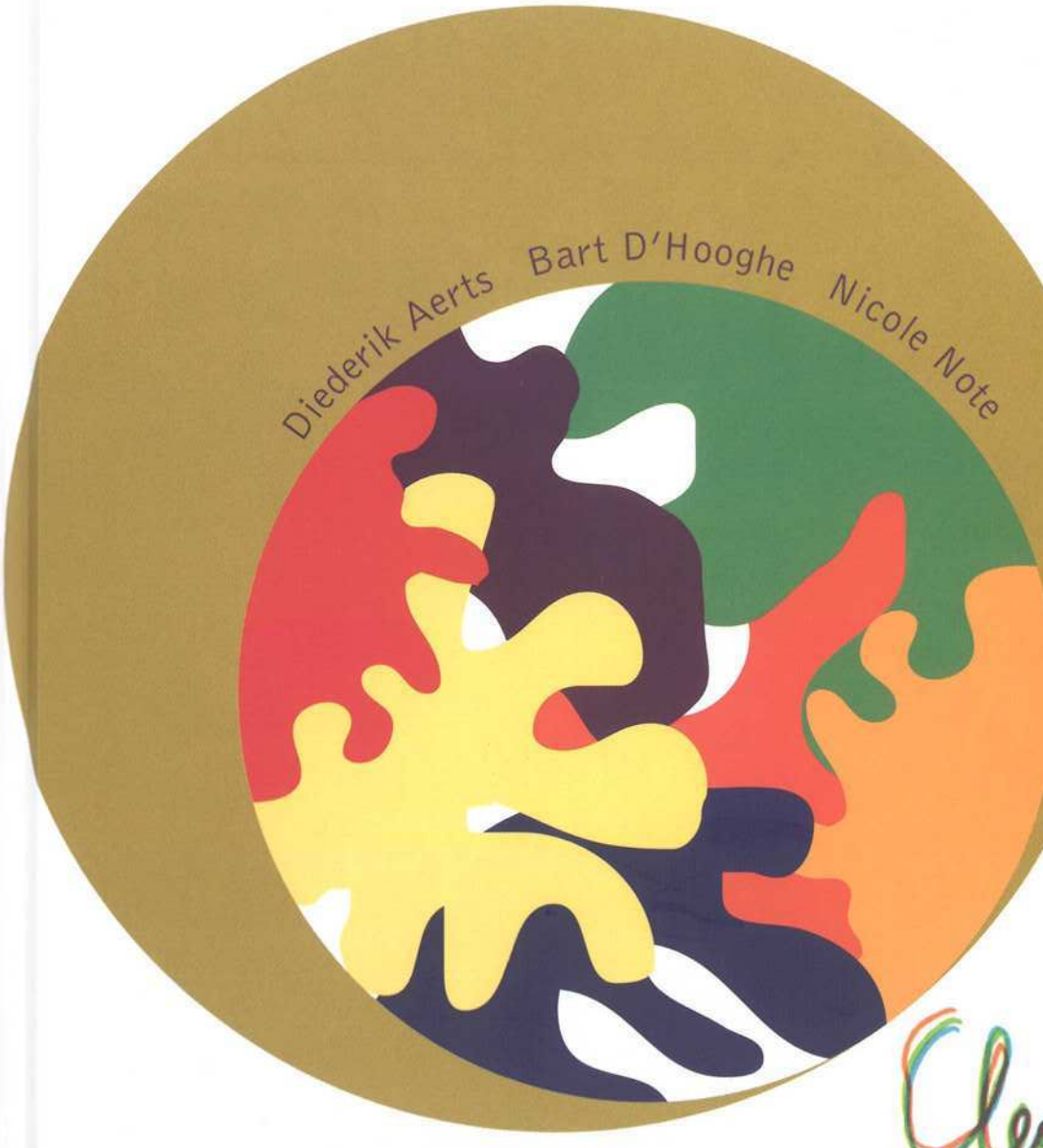
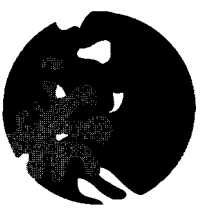
WORLDVIEWS, SCIENCE AND US

Redemarcating Knowledge and Its Social and Ethical Implications





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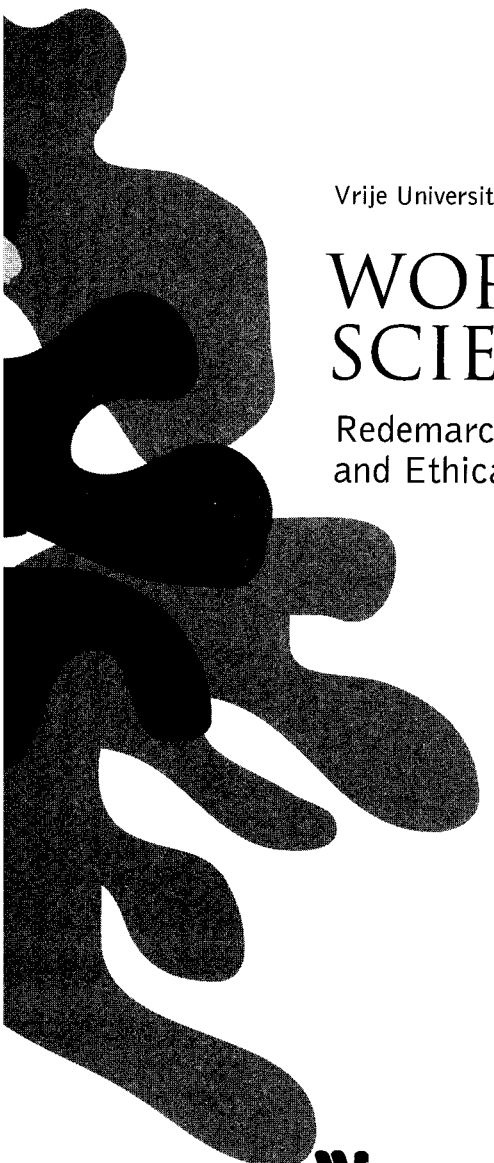

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WORLDVIEWS, SCIENCE AND US

Redemarcating Knowledge and Its Social and Ethical Implications

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CONTENTS

WORLDVIEWS, SCIENCE AND US, GLOBAL PERSPECTIVES

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This book originated in the regular meetings of several of the contributors — scientists of such diverse disciplines as philosophy, anthropology, ethics, physics, methodology, and quantum mechanics. During these meetings, the basic themes that are represented in the book were discussed. The meetings were organised as part of the activities of the research community "The construction of Integrating Worldviews", under the auspices of the "Fund for Scientific Research Flanders", headed by the Leo Apostle Centre of the Vrije Universiteit Brussel.

When the Leo Apostel Centre was founded in 1995, the central theme of research at the Centre, namely the construction of integrating worldviews, had been stated explicitly by the late Leo Apostel, one of Belgium's eminent philosophers. According to Apostel and his collaborators, a worldview can be defined as a coherent set of bodies of knowledge concerning all aspects of our world. It allows people to construct a global image of the world and understand as many elements of their experience as possible. A worldview is a map that people use to orient and explain, and from which they evaluate and act, and put forward prognoses and visions of the future. Hence: (1) orient; (2) explain; (3) evaluate; (4) act and; (5) predict are the basic aspects of a worldview.[1–5] CLEA presents these basic aspects as follows:

(1) An orienting model of the world (What are our implicit collective ontological conceptualisations of the nature of the physical, the social and the ethical worlds? In their own way, all three of them have an orienting function for human beings.)
(2) An explanation model (What range of epistemologies do we have (from phenomenological "verstehen" to materialistically explaining)

to understand these worlds, and in what way are they appropriate?)
(3) An evaluation model (In what way is our worldview able to coherently cover as many elements of our experiences as possible?)
(4) An action model (How can, do and should we act and create in this world? How do, can and should we influence and transform?)
(5) A rational futurology (What kind of future is ahead of us? And what are the criteria that guide us in our choices for the future?)
(6) A model of model construction (How to construct a model of the world such that we can answer the above questions?)
(7) Fragments of worldviews as starting points (What partial answers can be given to the above questions?)

As one can notice, "worldview" for Leo Apostel inherently included "science" and "society". The title of our book explicitly refers to these aspects of worldviews to make clear the strong relation within Western culture between worldviews, science and us. Any view of "how the external world ontologically is" will never be a neutral view, but rather one that is influenced by the scientific enterprise in its totality, most of all because in Western culture the status of science is paramount. An important aspect of science, for example, is its predominant focus on a materialistic conception of the world. On the other hand, the demarcations of science have been very much influenced by specific philosophical and societal ideals, ideas and discourses on the world. Both of these, science and philosophical and societal discourses, have an overriding influence on how we understand or judge ourselves as human beings and how we understand or judge other cultural constellations. They influence the way we structure society, and the way we (ethically) act. So there exists a complex relation between worldviews orienting individuals and sciences, philosophical and societal discourses and human actions giving rise to their own worldviews.

The overall objective of CLEA is the step by step construction of integrating worldviews. Due to a progressive specialisation of the sciences and multiple, sometimes contrasting results in different fields, science often leaves individuals with fragmented views about the body of knowledge of our physical, social and ethical worlds. Examples of major fragmented views in science, which lead to splits in our worldviews, are the ontological and epistemological positions about determination and free will, or the assumptions regarding the potentially knowable universe by sciences versus a knowledge-transcending part of reality. As a result, the main function of a worldview, *i.e.* its orienting power, is seriously hampered. CLEA's goal

is to integrate different scientific approaches of reality without, however, aspiring to reach the stage of one final universal and fundamental view. On the contrary, one plausible way of reaching integration might precisely be by taking the totality of compatible and incompatible views, with mutually incompatible views anyhow penetrating into a deeper ontology, much like the differences between two-dimensional incompatible perspectives reach out for a three-dimensional object.

The contributors of this book question aspects of our worldviews and of science that are often taken for granted — whether consciously or unconsciously — and that tacitly determine the boundaries of what we conceive of as "world", "science" and "us". Many of the contributors argue that existing demarcations are obsolete and often prevent new insights from emerging. Other contributions contain suggestions for re-demarcating science, sometimes under the nomination of "inclusive science". One of the goals of re-demarcation is to open the way for new crucial insights, and to stimulate the development of knowledge acquisition and social well-being. Some contributions analyse in detail examples of how knowledge in one field applied to a different field can lead to such new crucial insights, and how the pattern of too strict a demarcation of science — barring new insights — can be identified in these case studies.

The original intention was to write a book about non-exclusive and therefore "all-inclusive science". However, not all the authors were able to identify with this term. The specific sub-cultural context, interests and orientation towards reality differ from scientist to scientist and so do basic assumptions regarding science. Some authors, for example, naturally assume that the status of science will continue to grow within our worldview. They therefore deliberately opt for the broadening of science and for an "all-inclusive science", allowing space for ethics, the search for meaning, and other views of reality. Other contributors argue for a restriction of the status of science since they do not consider science capable of solving social problems or deciding political issues. Yet others, encouraged by experiences of an intercultural nature, are of the opinion that the Western, science-based model is waning. They emphasise the importance of multiplicity and the polylogue between varying views of reality or worldviews.

In what follows, summaries of the authors' accounts are given. Although only part of the existing boundaries are investigated, diverse possibilities are offered for a re-demarcation and a fundamental effort is made to defragment the Western worldview, as well as an effort to re-demarcate science in such a way as to take into account our ethical human experiences.

Ilja Maso asks the question how to distinguish science from non-science, and how to establish hierarchical relationships between scientific disciplines. Ever since the 1930-ies, these two questions have given cause for passionate debate but without yielding any consensus on the answers. This contribution outlines the standpoints of the principal participants in this debate, as well as the most relevant points of criticism of each of the positions. This criticism should reveal the fruitless nature of any attempts at formulating criteria to demarcate the scientific terrain and its hierarchy, and allow for a concept of science that is more suited to endeavours to acquire knowledge of the world and of ourselves than through any demarcation or stratification.

Alexander Riegler reflects on the notion of worldview within a radical constructivist framework. The epistemology of radical constructivism builds on the premise that cognitive activity consists of constructing a worldview out of experience. Every perception, and every action is the result of a construction process. Consequently, a worldview must be considered a theory about the world, in which experiences of various modalities relate to each other. This definition lends itself to extending the radical constructivist framework to the domain of strictly systematic theory formation, *i.e.* to science and — in the light of the human capability to interweave various modalities — to interdisciplinary research. In his article, Riegler reviews interdisciplinarity and its various definitions, points at its problems, and finally shows how radical constructivism can be fruitfully applied to overcome these obstacles.

Adri Smaling questions the centuries-old principle of simplicity or Ockham's Razor. This principle determines the nature of preferred theoretical explanations, the choice of research methods and techniques as well as the selection and conception of "data". Smaling wants to show that Ockham's Razor is not justifiable anymore on ontological or epistemological grounds. For instance, the ontological image of reality has evolved from simple to complex in different scientific disciplines. Therefore, he develops the Chatton–Ockham Strategy.

Jan Broekaert wants to see the richness of the ontology which emerges from modern scientific inquiry enter the public worldview in a way that better reflects its pristine nature. The shallow translations of science that are currently made for the sake of a better general understanding easily lead to a poor image of reality, if not of science itself. By contrast, the irreducible multiplicity of understanding at the frontier of science could lead to a more fertile view of reality. This "inclusive" approach to science, and its relation to society, definitely require a more substantial engagement,

which our complex and valuable world certainly deserves.

Roelof Oldeman explores the jungle to reveal that classical science is less universal than it seems. He rejects the notion of time as a linear, one-dimensional force, as well as the neat three-dimensional spatial boundaries and the present-day four-dimensional axioms in the study of man, organisms and ecosystems. The alternative view of the universe that he presents is inherently "elastic". The precise boundaries assumed by science sit inside broad borders or transition zones in time and space. As held by many non-European societies, volumes are elastic spaces and time is an elastic dimension. Oldeman claims that the old dilemma between structure (*being*) and process (*becoming*) can thus be solved. This image, with its own axioms, rather includes than replaces current science, which thus becomes one special case among many.

Hendrik Pinxten and *Nicole Note* believe that science can be understood to be culture-gender-context-sensitive or not. They claim and illustrate the importance of all these sensitivities in the description and normative approach (in policy, argumentation) of science. In the light of these remarks, the old debate of relativism versus objectivism is inadequate, since it is blind to these sensitivities most of the time. Social scientific research details the constraints which can be marked for scientific research. At the deepest or most impactful level, a civilisational perspective of heuristic relativism is the most interesting proposal.

René Devisch assumes all knowledge, including Western, to be culturally constituted. He advocates a deepened embedding of Western knowledge production in its own culture, and a rectification of our distorted views of knowledge production in other cultures. Devisch does not take a polarising approach towards Western science and indigenous forms and practices of knowledge, but purports to transcend simplified dichotomies in favour of a non-hierarchical polylogue of multiple views.

Koo van der Wal has doubts about materialist monism, and hence about the idea of the basic form of reality being dead matter. He also questions the relevance of restricting the content of philosophy to contextuality or to historicity. Van der Wal calls for a return to what he calls a high style in life, to be achieved through high style philosophy. This approach to philosophy should make room again for issues relegated to a marginal position by the currently prevailing worldview. Contrary to mainstream thinking, the author considers such issues to be of key importance.

Nicole Note, *Hendrik Pinxten* and *Diederik Aerts* emphasise that, contrary to what humans beings are subtly made to believe, the image of the

human self as part of our worldview is formed collectively. Consequently, individuals tacitly try to live up to this collectively established image for their orientation. The authors illustrate how today's collective image lies at the roots of deep individual-philosophical, social and ecological crises in Western society. In order to seriously tackle these problems, a conceptual change needs to occur. Note, Pinxten and Aerts therefore describe on the one hand the current collective image of the self as based on the development of two potentials, the rational potential and the potential for self-expression, which they define as indispensable, but also as overemphasised and misinterpreted. On the other hand, they conceptually introduce two other potentials, the ethical potential and the potential to be situated in a larger and meaningful whole. The authors claim that the introduction of these new potentials will place the development of the two former ones in a different discursive field, offering perspectives of a conceptual re-orientation on appropriate human action.

Diederik Aerts investigates how insights into the nature of quantum processes give rise to a proposal for a new and more natural democratic system. More concretely, he investigates how "consensus decision followed by majority voting" is open to "false play" by the majority, and how other types of false play appear in alternative types of democratic decision procedures. Introducing the combined notion of "quantum parliament" and "quantum decision procedure", he proves it to be the only one, when applied after consensus decision, that is immune to false play. This leads to the proposal of a new, more balanced democratic system, accompanied by a new voting system to favour parties and/or politicians that strive for a more stable and long-term policy as compared to a short-term or emotionally rooted policy.

Sven Aerts, *Diederik Aerts* and *Franklin Schroeck* wonder whether it is possible to form a coherent picture of a phenomenon, if studying the phenomenon leads to a classification that depends on the way we study it. A lead is taken from analytic geometry, which is a simple example of such a dilemma occurring. They show that the mathematics used in analytic geometry has (at least in the finite dimensional case) its exact counterparts in two other scientific disciplines of considerable importance: quantum mechanics and signal analysis. In some instances, the similarities are of such striking resemblance that many of the techniques employed in signal analysis were inspired by earlier, parallel evolutions in quantum mechanics. They argue that this is not a coincidence but rather the result of fitting complementary or mutually incompatible perspectives of a phenomenon into a single framework that is to describe the phenomenon. Without entering

too deep into the technical details, they outline some of the mathematical features that emerge in this framework and briefly examine the relevance for other scientific disciplines.

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ARGUMENTS IN FAVOUR OF INCLUSIVE SCIENCE

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How to distinguish genuine science from pseudo science, and how to establish the hierarchical relationships between scientific disciplines. Ever since the 1930-ies, these two questions have given cause for passionate debate but without yielding any consensus on the answers. In this contribution I will outline the standpoints of the principal participants of this debate, as well as the most relevant points of criticism of each of the positions. I will then try to show how this criticism should reveal the fruitless nature of our attempts at formulating criteria to demarcate the scientific terrain and delineate its hierarchy, and how instead we should allow for a concept of science that is more suited to our endeavours to acquire knowledge of the world and of ourselves than through any such demarcation or stratification.

Keywords: demarcation, science, pseudo-science, Wiener Kreis, logical positivism, logical empiricism, scientific family likeness, hierarchy of scientific approaches, reductionism, holism, inclusive science, openness, subject of science

1. The Distinction between What May and What May Not be Termed *Science*

About seventy years ago, members of the Vienna Circle made an attempt to develop a theory of science that was to shield it from metaphysical and any other types of "irrational" infiltration.[1] To achieve this, they set out to reconstruct and standardise science in rational terms. This enabled them to define those statements as logical — and mathematical — whose truths were based on the logical structure and on the meaning of terms *and* empirical statements referring to empirical reality, and distinguish them from metaphysical statements, which they regarded as non-sensical for being neither empirical nor logical.[a] Initially, they applied the principle of verification to

[a] Ref. 1, p. 4–8; cf. Refs. 2, 3.

draw the borderline between empirical and metaphysical statements (*Ibid.*, p. 5–6, 8–45), but, in view of the problems of this approach, subsequently chose to replace it with the principle of confirmation (*Ibid.*, p. 45–79).

One problem posed by logical positivism or logical empiricism, as it is called, is its premise. To establish a criterion of scientificity through rational reconstruction you must previously define what is to be regarded as science and scientific and what is not, whilst such definition is the very aim of your study. The scientific activities that qualify for rational reconstruction ultimately determine what is considered scientific and what is not. As a consequence, such activities as hermeneutics are labelled as non-scientific and therefore as non-sensical. Another problem is that the rational construction of science is by definition limited to existing science, so that it is static by nature, and this is in conflict with the history of science. A third problem is that it is logically impossible for empirical reality to say anything definitive about empirical statements.[4]

Karl Popper's distinction between genuine science and pseudo science is based on his criterion of regarding only those theories as scientific from which it is possible to derive hypotheses that in principle allow refutation through pre-formulated experiences and the prediction of new and unexpected facts.[5,6] However, as he himself noted, it is impossible to fully refute any theory. Since observations are theory-laden and based on background knowledge, they will always leave room for arguments against their reliability (*Ibid.*, p. 59, note 1), *ad hoc* hypotheses, *ad hoc* redefinitions of findings, as well as doubts about the competence and integrity of researchers or their work (*Ibid.*, p. 41–42, 81). According to Popper this kind of doubtful solutions is not only a rare phenomenon (*Ibid.*, p. 42), but can be circumvented by simply refraining from using them (*Ibid.*, p. 82). He makes an exception for the formulation of auxiliary hypotheses, which, he says, are allowed as long as they do not affect the falsifiability or testability of the theory (*Ibid.*, p. 83).

The problem about the falsification standard is two-fold: in practice, it is hardly ever applied, if at all,[b] and, if it had been followed more widely, it would have prevented such successful theories as William Prout's and Niels Bohr's from materialising.[c] Moreover, it is often verification, not falsification, that drives the development of theories (*Ibid.*, p. 137).

In Thomas Kuhn, a theory is scientific in so far as its existing and

[b]Ref. 4, p. 137, 176–177.
[c]Ref. 4, p. 138–154; also cf. Ref. 7, p. 8.

accepted formulation involves puzzles that can be resolved either within its own context or through adaptations of the theory.[7] If an accepted theory fails to yield a predicted outcome, researchers may for example check their data, measurements or test instrument to see if they are correct and/or to what extent the theory needs to be adjusted (*Ibid.*, p. 9). If it proves impossible to resolve such a puzzle, this is initially not ascribed to the theory but to the researcher (*Ibid.*, p. 5). Only after enough evidence has built up confirming the impossibility of resolving certain puzzles will it be acceptable to doubt the theory itself, and eventually replace it.[8] Any enterprise that does not involve this kind of puzzles, is not scientific, says Kuhn.[d]

One problem with this view is that the transition from one theory to another is dependent on the question — a question to be answered not in rational but in socio-psychological terms — to what extent the impossibility of resolving certain puzzles raised by the theory justifies such a transition.[e] Scientificity would thus depend on socio-psychological factors that themselves are not scientific. Another problem about Kuhn's criterion of scientificity is that it is also met by non-scientific activity, such as organised crime.[f]

Imre Lakatos discriminates between the scientific and the non-scientific by opposing research programmes defined as a series of subsequent theories to mere patched up patterns of trial and error.[g] Within a research programme, any theory is scientific or progressive if it explains more than the theories preceding it and leads to the discovery of novel facts (*Ibid.*, p. 116, 118, 132, 175).

As Lakatos himself admits, the problem about this criterion is that it is only afterwards, sometimes after a great many years, that we will be able to determine with certainty if adjustments to the theory have or have not led to the discovery of novel facts, *i.e.* if and to what extent the overall progressive development comprised a degenerative stage.[h]

It may have been this problem that induced Lakatos to develop another criterion for setting science apart from non-science by distinguishing between the internal and external history of subsequent theories. The internal history is rational and hence scientific because it can be explained in terms

[d] Ref. 7, p. 9–10.
[e] Ref. 7, p. 7, cf. Ref. 4, p. 93, 178; Ref. 9, p. 213–214.
[f] Ref. 9, p. 200.
[g] Ref. 4, p. 175.
[h] Ref. 4, p. 137, 155; Ref. 9, p. 215.

of a particular normative methodology, whereas the external history is by definition non-rational and non-scientific. One of the fields of study that come in the latter category is social sciences, which, according to Lakatos, could be regarded, in its most favourable sense, as proto-science, but in its less favourable sense as the offspring of a new but unwanted tradition.[10]

By thus restricting science to particular approaches in the realm of natural sciences, Lakatos sets a standard that proves to be of but limited value in the history of science. In any case, quite a number of approaches and disciplines are considered scientific in spite of failing to meet Lakatos' criterion.

Despite these little satisfactory attempts to determine what is and what is not to be regarded as science, there have been at least two other instances of scientists seriously trying to define this distinction.

Mario Bunge formulates ten varying but coherent criteria that are to be met *simultaneously* for a discipline to merit the epithet of scientific. Together, they lay the foundation for a complex typification of the characteristics of pseudo science.[11]

However, the problem with criteria such as "explanation through matter and laws of nature", "use of mathematical and logical theories and methods", and "discovery of laws" (Bunge in Ref. 12) is that they apply to physics as the only prototype [...] for Bunge's characterisation of the content of the term "science".[11] In other words, this would leave us with precious little science, which contravenes reality.

Lastly, Gerald Holton set out as a cultural anthropologist by giving a description of the thematic principles preferred by scientists in conducting their research and providing explanations. He showed these principles to be subject to change and their application to vary with context. In other words, he emphasised the contingency of any demarcation between genuine and pseudo science.

Later, in reaction to constructivism, creationism, New Age claims *etc.*, Holton stated that his description of thematic principles should be seen as prescriptive. However, since this did not neutralise the contingent nature of his distinction between the scientific and the non-scientific, his thematic principles too proved inadequate as a scientificity criterion.[13]

In view of all the above, it will come as no surprise that a number of well-known philosophers of science have come to the conclusion that a clear-cut demarcation between science and non-science is inconceivable. Paul Feyerabend, for instance, defends the idea that scientific progress requires opportunism, in the sense that it should be possible at particular

moments to violate proposed methodological rules and that there is no uniform way to explain scientific successes.[i] Larry Laudan thinks attempts to separate science from pseudo science are little more than hollow phrases having only emotional meaning.[j] Steve Fuller, finally, argues that science is distinguished from non-science mainly through social negotiations in which the parties involved justify their standpoints based on their own interests and those of the scientific community to which they belong (*Ibid.*, p. 54–56).

Does this mean that, in the words of Feyerabend, anything goes and that science is no more rational than astrology, black magic or voodoo? To draw that conclusion would be a mistake for more than one reason. It is not so that anything goes, if only because some activities are regarded as non-scientific by scientists and/or the media *and* are therefore not supported financially nor published in scientific journals. The scientific quality of activities will not be acknowledged until those that execute or support them constitute a powerful, scientific community or can make a strong case for convincing a relevant scientific community of the scientificity of their project. The nature of such a strong case may vary considerably, but the one thing that is certain is that the activities concerned should link up with what is being considered scientific, or — which is far more difficult — convincingly prove the currently prevailing conception of science to be inadequate in many relevant ways. It is important that the results of the activity whose scientificity is being claimed, can be regarded by the relevant scientific community as useful for their scientific activities or as applicable to the world outside.

This is not to say that the distinction between science and non-science is or should be made purely in terms of authority, power, money and achievements. Activities are definitely termed scientific for revealing particular characteristics. Indeed, we have already pointed out some of these. We have said, for example, that statements or theories should at least in part be verifiable by practical experience. We have also said that new theories must build on earlier theories and research and that it must be possible to solve problems related to incorrect predictions and anomalies largely within the framework of existing and accepted theories. In addition to this, Kuhn points to the need for simplicity, precision and congruency with theories used in other specialisms,[k] and Lakatos, to the relevance of consis-

[i] Ref. 11, p. 10.
[j] Ref. 13, p. 52–53.
[k] Ref. 7, p. 21.

tency.[1] Other characteristics required of scientific characteristics, without in any way pretending to be exhaustive, are argumentative cogency and methodological qualities such as virtual or real repeatability, reliability and validity.[14]

The question arises whether these and any other criteria do not suffice to establish the borderline between science and pseudo science. I think the answer to that question must be no. The reason for this is that the qualities for which a particular activity or sub-activity is regarded as scientific vary with culture and time. Any comparison of the different activities will at best yield — what Wittgenstein called — family resemblances, *i.e.* a complicated network of similarities overlapping and crisscrossing: sometimes overall similarities, sometimes similarities of detail.[15] Inevitably, the distinction between science and non-science will therefore be blurred, and each criterion used to underpin such distinction will be arbitrary in a sense. It is of course possible to establish such a criterion as a standard, particularly within a specific scientific community, and specially if it is supported not only by authority but also by power, money and achievements. But even then, it will be short-lived.

2. The Hierarchy of Scientific Approaches or Disciplines

The debate on what are to be considered acceptable criteria for scientificity and the way in which activities are regarded as scientific in practice is interwoven with another debate, to wit the debate on which approach and/or scientific discipline is to be considered the most scientific. We have encountered elements of this attitude in Lakatos' positioning of social science as proto science and in Bunge's implicitly writing off anything outside the sphere of physics.

Broadly speaking, there is a tendency to hold those scientific approaches or disciplines in highest esteem that are founded on materialist, mechanist and reductionist assumptions. It is these approaches and disciplines that receive the largest piece of the financial pie, and are alleged to produce the most appealing results and employ the smartest brains. The greater its deviation from these assumptions, the further down an approach will tumble in the hierarchy and the less money and status it will be granted.

Indeed, we can establish the precise ranking by using these assumptions. We will discuss a limited number of disciplines to illustrate this hierarchi-

[1] Ref. 4, p. 143.

cal interrelationship. Lowest of all comes mysticism, which can be reduced to theology. Theology in turn can be reduced to social science, which is nothing but psychology, which is nothing but physiology, which is nothing but biology, which is nothing but chemistry, which is nothing but physics of solid state, which is nothing but physics of particles, which is nothing but mathematics.[16] Lewis Wolpert refers to this reductionist hierarchy, for instance, where he expresses his concern about the complexity of the phenomena studied by social scientists making it virtually impossible to conduct any experiments comparable to experiments in the area of physics, while all scientific disciplines, he argues, strive in a way to be like physics, with physics itself emulating mathematics (Wolpert in Ref. 17, p. 90).

This hierarchisation entails several dangers, the first of which is that of the lower ranking disciplines trying to achieve such transformation as will enable them to rise as high as possible on the ladder of hierarchy, thus dispelling other approaches that are often more promising. One example of this phenomenon is the transition from psychology to behaviourism that caused the kind of research advocated by John Dewey and William James to disappear (*Ibid.*, p. 97). Even today, according to Mary Midgley, something similar is about to happen in psychology under the two-fold influence of research done into artificial intelligence and Richard Dawkin's meme theory (*Ibid.*, p. 92–94). A second danger is that a disproportionately larger amount of money will go to the upper levels of the hierarchy, while it is the lower areas that deal with the characteristics, needs and problems of people. The particle accelerators that physicists need to elaborate and test their ideas on a unified theory, for instance, cost billions of dollars. The same can be said about all kinds of space projects carried out in support of research into astrophysics, while none of these projects are likely to contribute much, if at all, to resolving such worldwide problems as contamination, overpopulation, poverty, deforestation, loss of biodiversity, terrorism, racism and oppression.[18] A third danger is that a particular culture may come about in the upper areas of the hierarchy that will make it difficult for certain groups — that otherwise do have the relevant skills and expertise — to join or retain their position there. According to Margaret Wertheim, its halo of religious, priestlike culture have traditionally proved very considerable obstacles for women in holding their own in this environment (*Ibid.*, xiii–xiv, p. 8–9, 11–16). She is talking from experience, for following her six-year studies of physics and mathematics she realised that in spite of her love of the subject, she would not last in the alienating ambiance typical of mathematics and physics practice (*Ibid.*, p. 15). The fourth danger is that

the idea may arise of the higher ranking disciplines providing a truer view of reality than the other ones. In its most extreme form, this has resulted in scientism, *i.e.* the belief that all things in the universe, including all living things, are made up of protons, electrons and neutrons, with the controlled experiment being the only reliable scientific method.[19] On these grounds, supporters of scientism often believe that physics in particular is capable of describing things as they are, solving all real problems and satisfying all legitimate needs of the human intellect.[20]

As opposed to this reductionist hierarchy, we can find the holistic hierarchy developed by Kenneth Boulding and afterwards adopted by Ludwig von Bertalanffy.[21] In this hierarchy, static structures such as atoms, molecules en proteins occupy the lower ranks, successively followed by dynamic systems such as the solar system, cybernetic systems such as biological homeostasis, open systems such as cells, and subsequently by vegetable organisms, human organisms and socio-cultural systems, with transcendental symbolic systems finally occupying the highest position.[m] If we link scientific disciplines to these hierarchical levels, the outcome is almost diametrically opposed to reductionism. Disciplines such as philosophy, art history and literary theory rank highest, followed by social science, psychology, physiology, biology, astronomy and finally, ranking lowest, physics. As with the mystical hierarchy, on which the holistic hierarchy seems to be founded (see for example Ref. 23), these hierarchies do not focus on the question to what extent a discipline or approach can be reduced to a simpler whole, but rather on the question to what extent it transcends and comprises the previous level. Biology makes use of physics, for instance, but not the other way round. The underlying assumption is that the higher can be neither explained nor derived from the lower.[n]

As long as the holistic hierarchy has to do without the status and the prestige granted to the reductionist view, it will be hard to gain a clear insight into the dangers it entails. At this moment, I am aware of only one phenomenon that may be indicative of this, to wit the danger that a variety of disciplines and approaches will attempt to transform in such a way as will allow them to occupy the highest possible position in the holistic hierarchy, thus dispelling other approaches that are often more promising. Attempts to establish forms of interdisciplinary research using philosophy, social science and human science appear to be biased towards philosophy

[m] Ref. 21, p. 7; Ref. 22, p. 13.
[n] Ref. 23, p. 153; also see Ref. 21.

at the cost of the social and human sciences.

By pointing out that the acceptance of a holistic hierarchy entails dangers too — dangers that in the end need not be any smaller than those attached to the reductionist hierarchy — I hope to make clear that I am not concerned with replacing the latter with the former. I would rather suggest to regard the multiplicity of these hierarchies as a reflection of the multifarious, mutually complementary and equally valid and fundamental ways of approaching phenomena. To give an example: from a physicist's point of view, the movement of a car may concern the explosion of petrol in cylinders, from a chemist's point of view, the break-up of molecular links during the combustion process, from a biologist's and physiologist's view point, the contraction of a particular muscle that causes the accelerator pedal to be pressed, from a psychologist's point of view, the manifestation of a particular motivation, from a social scientists point of view, an expression of social behaviour, and from the philosopher's point of view, the temporariness of movement.[24] None of these points of view are better or more fundamental, while together they present a clearer idea of the examined phenomenon than individually.

3. Inclusive Science

The discussion of the search for a criterion of scientificity and for the hierarchy of relationships between scientific approaches and disciplines has several consequences.

As regards the hierarchy, they have already been pointed out: if we were to abandon any attempts at hierarchisation, promising approaches and disciplines would not have to make room for less promising approaches, more resources would be available to resolve the problems and needs of the world we live in, it would be less difficult for certain groups to work within any approach or discipline, and the picture painted us of reality would be less commonplace and much more varied.

Our discussion has been less explicit on the consequence for the criterion of scientificity. If we acknowledge that the border area between science and non-science is blurred and that a clear distinction between the two cannot be made, it follows that we would no longer label as non-scientific or pseudo-scientific those approaches and disciplines whose degree of scientificity cannot be ascertained, but would rather give them a provisional welcome as potentially valuable additions to the limitations of existing and established approaches and disciplines. In the same way, the distinction

between science and philosophy would decrease and possibly vanish altogether, so that philosophers and empiricists might pluck the fruits of greater mutual openness.

There is a third consequence wholly implicit within those we have enumerated, *i.e.* that which Abraham Maslow called the primary rule of science:

> "[It is] acceptance of the obligation to acknowledge and describe all of reality, all that exist, everything that is the case. Before all else science must be comprehensive and all-inclusive. It must accept within its jurisdiction even that which it cannot understand or explain, that for which no theory exists, that which cannot be measured, predicted, controlled, or ordered. It must accept even contradictions and illogicalities and mysteries, the vague, the ambiguous, the archaic, the unconscious, and all other aspects of existence that are difficult to communicate. At its best it is completely open and excludes nothing. It has no 'entrance requirements'." (Maslow in Ref. 25, p. 72)

It is not by accident that several scientists have chosen to use the term *inclusive science* to refer to an approach of science that ensues from the consequences described above. A few examples follow. Mary Midgley wonders what became of the inclusive concept of science, referring to the tradition that lasted into the early years of the nineteenth century according to which scientists would not refer to any authority or tradition in dealing with their subject but instead select their methods and argumentation solely based on the principle of usefulness.[o] Jennifer Altman points to inclusiveness as one of the lessons to be drawn from Eastern traditions. Instead of Western either/or thinking, science should combine subjectivity, intersubjectivity and quantitative, third-person approaches by tracing their interrelationships.[26] Lastly,[p] Maslow argues that science should be all-inclusive and enable scientists:

> "to enjoy not only the beauties of precision but also the pleasures of sloppiness, casualness, and ambiguity. They are able to enjoy rationality and logic but are also able to be pleasantly crazy, wild, or emotional. They are not afraid of hunches, intuitions, or improbable ideas. It is pleasant to be sensible, but it is also pleasant

[o] Ref. 17, p. 89.
[p] Ref. 25, p. 82.

to ignore common sense occasionally. It is fun to discover lawfulness, and a neat set of experiments that solve a problem can and does produce peak-experiences. But puzzling, guessing, and making fantastic and playful surmises is also part of the scientific game and part of the fun of the chase. Contemplating an elegant line of reasoning or mathematical demonstrations can produce great esthetic and sacral experiences, but so also can the contemplation of the unfathomable."(Maslow in Ref. 25, p. 31.)

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INCLUSIVE WORLDVIEWS: INTERDISCIPLINARY RESEARCH FROM A RADICAL CONSTRUCTIVIST PERSPECTIVE

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Interdisciplinary inquiry presupposes an open worldview to enable the researcher to transcend the confinements of a specific discipline in order to become aware of aspects that are necessary to satisfyingly solve a problem. Radical constructivism offers a way of engineering such interdisciplinarity that goes beyond mere multi or pluridisciplinary approaches. In this paper I describe epistemological and methodological aspects of interdisciplinarity, discuss typical problems it faces, and carve out its relationship with knowledge and communication from a constructivist perspective. Five implications for interdisciplinary practice and science education conclude the paper.

Keywords: radical constructivism, black-boxing, knowledge, meaning

1. Introduction

To me, science has always been an interdisciplinary endeavour. When I enrolled at university, I intended to carry over the passion for astronomy I had developed in high school. But taking to the computational approach, I also became intrigued by the idea of building computational models of that which enables human scientists to do their job in the first place: cognition. In those days, I considered artificial intelligence a sort of meta-solution to current problems in science. Rather than solving the actual problem, the solution concerns methods that solve a class of problems, *e.g.* all those scientific problems that arise due to cognitive insufficiencies of the human researcher. Soon I changed to study artificial intelligence and cognitive science and experienced my first "paradigm-switch" from mathematics-based science to computation-based research. Of course, the expectations re-

garding AI as a meta-solution strategy did not materialize: no genuine AI systems have been introduced in society until now. Rather, as many have always argued (*e.g.* Dreyfus[1]), the creation of cognitive artefacts is still as hard a problem as it was in the days of Alan Turing some 50 years ago when he published his seminal paper of computing machinery.[2] So after graduating, instead of following the path of AI, I prepared myself for another paradigm-switch and started to work for theoretical biologists. The biologists' worldview has left an equally dominating impression on me, as has the computational approach of AI scientists. During all this time, I never considered the division of science into relatively isolated disciplines to be an advantage (and worse: sub-disciplines such as theoretical biology was always looked at askance by, say, marine biologists working just one floor below me). Quite the contrary: the idea of an inclusive scientific approach seemed more promising to me, *i.e.* studying a particular phenomenon or topic using methods and insights from peers from various disciplines pertaining to the natural-scientific worldview, to the engineering approach or to philosophy. It is based on the — almost trivial — definition that science (lat. *scire* = to know) is about enlarging one's knowledge (and skills). It is only "almost trivial" as an exact definition in the sense that what counts as "knowledge" and how to communicate such knowledge in "language" still seems elusive, in spite of the key importance of these terms for the practicing scientist and philosopher. The following will therefore explore the problems of interdisciplinary practice and how they relate to knowledge and communication from the perspective of radical constructivism.

2. Why Philosophy and Science?

As is well known, Ludwig Wittgenstein defined the philosopher's work in terms of "assembling reminders for a particular purpose".[3] If one considers this the most general characterisation of how *philosophical* knowledge is enlarged, the question arises whether this does not also apply to knowledge acquisition in general, that is, whether it is accurate to portray scientific activity as the (systematic) collection of experiences.

The philosophy of *radical constructivism* (RC) takes up this idea and examines the question of how knowledge comes about. For example, according to Ernst von Glasersfeld, who coined the notion of RC some 30 years ago, knowledge constitutes a dynamical product of construction processes in the stream of experience. Whether knowledge reflects any mind-independent reality must remain a matter of speculation. What is more,

constructivism opposes the notion that different modes of knowledge acquisition can be considered equal. Rather, it is especially the scientific method that lends itself to assembling various experiences into a coherent whole in order to create both explanations and predictions. (For example, in the natural sciences the scientific method consists of, in rather abstract terms, (1) the idea of reproducibility, *e.g.* in terms of formal descriptions of the phenomenon in question, and (2) building on the work of peers by making explicit references to their publications.)

As the introduction sought to illustrate, scientific disciplines do not progress in a united manner, neither with respect to their methods nor regarding the set of questions they try to account for. Rather, science is split into what philosophers of science have called *Denkkollektive*,[4] *paradigms*,[5] or (*metaphysical*) *research programs*.[6,7] Starting from the fact that science is fragmented, I want to pose the following questions. Firstly, do we need interdisciplinary research to counteract this fragmentation; are there already instances of interdisciplinarity; and what are its advantages? As I will point out below, the answer is mainly positive. Yes, we need interdisciplinarity, examples do exist, and there are advantages of interdisciplinarity over narrowly focused disciplinary research. Consequently, I ask the second question: What problems does interdisciplinarity entail, and can we overcome them? In order to find an answer to this second question, I will formulate an alternative perspective of interdisciplinarity based on radical constructivism. The goal of this paper is to stimulate scientists involved or intending to get involved with interdisciplinary research to reconsider central concepts of research such as knowledge acquisition and language communication. These concepts are considered crucial for fruitful interdisciplinarity.

3. Why Interdisciplinarity?

"Interdisciplinary" has been a buzzword for at least 60 years. Some consider the development of the atom bomb as the first large-scale interdisciplinary research, other regard even early industrial parks such as Thomas Edison's Menlo-Park as first successful attempts in this direction. The first interdisciplinary conferences took place after World War II, most notably the meetings of the Josiah Macy foundation held to discuss "circular-causal and feedback mechanisms in biological and social systems".[8] Their goal was to initiate a kind of science that was later to be called "cybernetics" (cf. Norbert Wiener's 1948 book "Cybernetics"[9]). Their participants

included neurologists, psychologists, philosophers, anthropologists, mathematicians, engineers and so on. The basic attitude of cybernetics — to approach complex phenomena from different disciplines — has caught on in many research circles. Their common goal was and is to provide environments for extensive collaborations among scientists from various disciplines. The result of such efforts has become visible in various disciplines that call themselves "interdisciplinary." For example, cognitive science is considered a multi-facetted approach to exploring human cognition from a variety of disciplines, including psychology, computer science, philosophy, anthropology, and so on.[10] Biotechnology is another, particularly recent and financially successful amalgam of chemistry, biological and computer sciences. An older example is behavioural science, which late 19th century philosopher Edmund Husserl characterised as interested in a broad and integrated treatise on organisms based on both natural scientific disciplines such as zoology and ethology and humanistic disciplines such as human ethology.[11] Quantum computing is also considered an interdisciplinary effort for combining physics with computer science.[12] The list can be arbitrarily extended.

What is at the core of such interdisciplinary endeavours? The answer, as we will see, concerns mainly methodological and epistemological considerations.

The *methodological issues* relate to the fact that interdisciplinarity is an open inquiry that enables the investigator to escape the confinements of a specific discipline in order to become aware of aspects that are necessary to satisfyingly solve a problem. What do I mean by that? Consider the following example.[13] Suppose that we take a piece of chalk and write on the blackboard "A = A". We may now point at it and ask, "What is this?" Most likely we will get one of the following answers. (a) White lines on a black background; (b) An arrangement of molecules of chalk; (c) Three signs; (d) The law of identity. Regardless whether you are an art critic, a chemist, a philosopher, or a mathematician, it is obvious that the answer will depend on your educational background. There seems to be no harm in that at first sight, but let us consider another analogy. A teacher "who asks a student to measure the height of a tower with the use of an altimeter, may flunk the student if he uses the length of the altimeter to triangulate the tower and obtains the height of the tower through geometry and not through physics. The teacher may say that the student does not know physics".[14] What this episode suggests is that by focusing on one particular approach only we will quickly get caught in ignorance and denial of other approaches

that might turn out much more fruitful.[a] Of course, such is the human psyche: functionally fixed.[16] Once we have found a viable solution we tend to stubbornly apply the pattern of our solution to all other problems as well. In his famous experiment, Karl Duncker posed the task to support a candle on a door. The items available to the test subjects were matches and a box filled with tacks. Since the test subjects regarded the box as a mere container they failed to empty it in order to tack it to the door where it could serve as a support for the candle. In other words, our thinking is canalised (cf. the "If it ain't broken don't fix it" syndrome[17–19]), caught in the momentary situational context as determined by the way we have learned to deal with things.

The *epistemological considerations* refer to our subjective qualitative and shared social conceptual framework, usually called "worldview." According to Aerts *et al.*,[20] a *worldview* can be described as a system of co-ordinates or a frame of reference in which everything presented to us by our diverse experiences can be placed. Such a representational system allows us to integrate everything we know about the world and ourselves into a global picture, one that illuminates reality as it is presented to us within a certain context or society. As human beings, we face the problem of integrating experience every day. Observations that do not fit into an existing network provide a feeling of "uneasiness" that needs to be resolved. If the tension between new fact and worldview is bigger, fundamental problems arise, and if two worldviews collide in a social context we are often facing an unsolvable problem. (In functional terms this can be compared with Piaget's notion of accommodation of cognitive schemata triggered by experiences that cannot be assimilated into the schemata.) Consequently, the question of interdisciplinarity is tightly connected with that of worldviews: we need a better understanding of how worldviews come about, which rules they obey, and how controversial observations can be integrated in order to avoid fragmentation of knowledge among the more than 8000 distinguishable disciplines today. As Klein put it,[21] "The task for philosophers of science is to specify conditions that promote integration and to formulate criteria to evaluate integrations."

[a]Maturana's thought experiment refers to the classical anecdote "The old barometer story". In recent internet versions of the story the student is claimed to be Niels Bohr. Given the high respect Bohr had of his teacher Christian Christiansen,[15] this seems unlikely. In addition, a version of the story that does not refer to Bohr appeared in print already around 1960.

4. Problems of Interdisciplinarity

While the idea of interdisciplinary scientific activity seems to be attractive at large, it is often hampered by problems in practice. Whenever people come together to participate in a common project, different personalities meet each other with their own educational backgrounds. For collaborating scientists, this has two immediate effects.[22] (P1) there is usually a *mutual information deficit* that roots in a good deal of ignorance of other fields. Such ignorance may have deliberate reasons, including a dim view of the other discipline: "Teamwork has been compromised by the disdain scientists have for engineers, mathematicians for physicists, pure scientists for applied scientists, physical scientists for social scientists and humanists and *vice versa*"[23] (quoting Klein[24]). However, mutual information deficit can also be caused by the (cognitive) impossibility to deal with details of an unfamiliar discipline. (P2) Connected with the first point is the problem of *not sharing a common terminology* due to specific jargons. These are words and expressions "ready-to-hand" for the specialist and incomprehensible or at least misleading for the rest. They are typical of the *Denkstil* (style of thought[4]) a particular research community uses, which ultimately results in *Bedeutungsverschiebungen* (semantic shifts) when attempts are made to "translate" typical expressions among various groups or to the public. Language problems also affect the transformation of interdisciplinary results into readable publications, for, as the adage goes, "too many cooks spoil the broth". The traditional way to get around the jargon problem and obtain a proper interface between participants is by creating redundancy through repetition — in much the same way a young child is exposed to repetitions in order to learn her first words. A long tail of philosophical considerations is linked with this, as well as other language and communication problems, which makes it worth looking at them in more details further below.

Further problems address the different ways of scientific work. Some of the basic dimensions are (P3) *Prediction versus explanation.* Mathematically inclined disciplines tend to emphasise the predictive value of their work, or they try to cling to it, as we know from meteorology. In contrast, humanities seek to account for events and data, with historical and literature science at the far end of the spectrum. It is interesting that phenomena whose degree of complexity transcends the threshold of computability cannot be predicted with quantitative deductive rules, *i.e.* they seem to cease to be scientific problems and become philosophical, religious, and/or com-

mon sense problems. Foerster wrapped this insight into his well-known bon mot: "Only the questions which are principally undecidable, we can decide".[25] In these cases, prediction recedes into the background in favour of the pursuit of explanations, which in the humanities has even led to prediction playing a marginal role. (P4) Very similar to problem P1 is the *hard sciences versus soft sciences* contrast, which in many ways corresponds to the distinction between the two cultures introduced by C. P. Snow,[26] widespread in philosophy of science. The soft sciences study humans and human societies as opposed to non-living matter, which is explored by hard science. Therefore, they have to rely on different test and evaluation criteria, which impose severe limits on repeatability — the notion so central to the scientific method. Heinz von Foerster once pointed out that the "hard sciences are successful because they deal with the soft problems; the soft sciences are struggling because they deal with the hard problems".[27] This is the case because the "more profound the problem that is ignored, the greater are the chances for fame and success". Of course, Foerster is hinting at the reductionist approach in physics, which made it easy to focus on a particular tiny problem, within a closed framework, and to forget about the rest of the universe, including the views of others. In this regard, reductionist science as the piecemeal advance by tackling picayune though manageable problems is opposed to large-scale systematic approaches. (P5) *Basic research versus applied science*, or: Does science have to answer to needs of society exclusively? Questions like this refer to the importance of worldview creation, as described above. (P6) *Single scientists versus group research.* Of course the border is blurred. As Thomas Kuhn already pointed out,[28] science is carried out by individuals but scientific knowledge is the result of a community. However, the flexibility of the single researcher might be considered higher compared with the necessarily more rigid organisation of interdisciplinary groups and their internal methodological and linguistic co-ordination.

5. Towards a Definition of Interdisciplinarity

Interdisciplinary research does not occur spontaneously. Rather, it has an "evolutionary" dimension. For example, what begins as an interdisciplinary effort often results in the creation of a new discipline that is narrowly focussed again. As Frodeman, Mitcham and Sacks pointed out, "biophysics has not really united biology and physics but created another and even more narrow discipline; the same goes for fields like biochemistry

and paleoclimatology".[29] The same applies to artificial intelligence and cognitive science, which are well-established disciplines today with their own respective methods, vocabularies and journals. (However, some do not consider cognitive science a new discipline but rather an instance of what Bechtel called "cross-disciplinary clustering".[30] Although it has conferences and journals devoted to its programme, its practitioners remain within their original discipline.) In what follows I claim that such disciplinary developments are far from being unnatural.

A typical phenomenon in scientific praxis is what Bruno Latour called "black-boxing".[31]

> "Once a device or an experiment or finding is black-boxed, it is treated as an unquestionable fact: no one needs to look inside that particular black box again [...] Procedures or devices or equations or facts are taken for granted by future generations of scientists and may be virtually incomprehensible to outsiders."

Of course the cognitive basics of black-boxing are easily recognisable as the black-boxing of skill can be applied to many human domains, including writing and music. Musicians, for example, once they have mastered the basics of playing their instruments will feel free to creatively re-arrange pieces of music. They have grown familiar with these chunks to the extent that using them no longer requires conscious reflection. In other words, while being complex enough to make beginning and less skilful players struggle with them, these musical "chunks" have become "cognitively closed" in the cognition of the advanced. Such "higher order compositions" play a central role in musical techniques such as sampling where parts of a song are combined with parts of other songs.

In science, such closures appear at various levels, from simple procedures to methodologies and — extrapolating Latour's claim — entire research groups that wrap them into new disciplines. If my extrapolation is correct, we can predict that "disciplinary" black-boxing takes place in several steps, evolutionarily transforming a set of single disciplines to a single, tightly homogeneous approach. Indeed, in the literature we find such taxonomies of different degrees of interdisciplinarity, *e.g.* the one proposed by Erich Jantsch.[32] He distinguishes the following steps of aggregation. At the *multidisciplinary* stage, a variety of disciplines meet up simultaneously and work on several goals without co-ordination and maintaining explicit relations. The respective paradigms of the disciplines remain unaltered by this loose form of co-operation. One may think of informal conference

conversations among unrelated scientists or even reading literature outside one's own area of expertise as a form of multidisciplinary collaboration. Evidently, there are also negative forms of multidisciplinarity, as described by Scerri,[33] who quotes from an interview: "The philosophy of our lab is to try to steal as many technologies as we can from other disciplines and to apply them to our problem." In some respect, such procedures may also be considered the drawback of what Gibbons *et al.* called "Mode 2" research,[34] *i.e.* the fact that scientific knowledge is no longer exclusively produced at universities and that it is primarily problem-focused. The *pluridisciplinary* stage is marked by the juxtaposition of more or less related disciplines which communicate on the same level, but again without changing the character of the participating disciplines. Only at the *crossdisciplinary* level can a tendency of asymmetry be observed. One discipline starts to dominate the others, establishing itself as leading discipline, for example with regard to the predominant methodology. This relegates the other participating disciplines to a merely auxiliary position. The result is one-level, one-goal guidance rather than co-ordination. The programme of the Vienna Circle was characterised by the attempt to make physics such a prevalent science. Another, almost opposing example is psychologism, where the basic foundations of other disciplines are explained in terms of psychological laws (*e.g.* Ernst Mach[35]). On the "serving" side we find eminent disciplines such as philosophy. From the perspective of empiricist John Locke, philosophy is the under-labourer to master-builder science in the building of knowledge, sweeping away the debris of erroneous and other traditional ways of thought in order to clear the way for unhindered scientific investigation. The self-assessment of analytical philosophy confirms this view, *e.g.* Searle,[36] who considers philosophy a scout exploring the unknown terrain before science moves in. Also cybernetics, which began as an interdisciplinary effort, soon started to presume a leadership role in the 1960s. Eventually, however, with the exception of some incorrigible researchers who still think they can tackle science's hardest and other philosophical problems with simplicistic cybernetics, this crossdisciplinary presumption led to its decline in the 1970s.

According to Jantsch,[32] it is only at the level of *interdisciplinarity* that disciplines are emancipated enough to enter a collaboration characterised by extensive cross-communication and mutual co-ordination against a common perspective. The ultimate stage is the state of *transdisciplinarity*, in which the borders between disciplines have faded and scientists have lost their discipline-specific identities due to a maximum of cross-communication and

co-ordination. As mentioned above, this may result in the creation of a new methodologically and terminologically independent discipline.

To sum up, interdisciplinarity is the attempt to overcome the tendency of crossdisciplinarity to subordinate participating disciplines to a single prevailing discipline, resulting in scientific reductionism. The systems-orientation of interdisciplinarity offers many opportunities, including the avoidance of scientific impasses, which are a consequence of cognitive canalisation.[18,19] However, it may also lead to pitfalls if there is insufficient reflection on central notions such as *knowledge acquisition*, *understanding*, *cognition* and *communication*. In the following section, I will embark on these conceptions from the perspective of radical constructivism. My goal is to provide a more thorough apprehension of these notions, especially in relation with interdisciplinary research, where the formation of interfaces between participating scientists very much hinges on mutual *co-ordination* in *knowledge* and *language*.

6. Why Radical Constructivism?

Generally speaking, science is a directed, constructive approach to knowledge acquisition. It assures the credibility of its results by developing a methodology and tests of the "truth" of its conclusions. In order to put forward a methodology that is sound for a purpose, one necessarily rejects everything that is not covered by this methodology. If one values the systematic recording of observations, anything resembling random observation and the unsystematic gathering of impressions will appear a waste of time, even if it is considered important against the background of another discipline's methodology. Furthermore, it has been recognised for quite some time that predispositions and biases affect the result of a scientific inquiry, but they have been considered distortions of rational judgment. An alternative perspective, however, calls for a revision of this understanding and new light on the role of biases in the process of research and knowledge acquisition. Does it make sense to suppose that carrying out scientific inquiry is to record regularities and systematicities as an objective state of affairs? Or are these systematicities only apparent in one's consciousness within the framework of certain perceptibility and a sense of their significance in the light of this framework? If we are to profit from working together with people from *different* backgrounds, despite potential disagreements, the question arises of how we are to surpass this "framework problem" in order to gain new knowledge? As Frodeman, Mitcham and Sacks rightly

recognised,[29] it is necessary to reopen "negotiations about what counts as information or knowledge" in order to extend the epistemological limits of interdisciplinary research. Radical Constructivism (RC) provides the basis for such negotiations.

A cognitively motivated access to RC is its notion of *organisational closure*. It is a necessary quality of cognitive beings based on the *Principle of Undifferentiated Encoding* of nervous signals. Heinz von Foerster described this ubiquitous neurophysiologic insight as follows. "The response of a nerve cell does *not* encode the physical nature of the agents that caused its response. Encoded is only 'how much' at this point on my body, but not 'what'."[37] Think of the behaviour of young birds that open their beaks whenever the parent bird comes along with some food. As numerous ethological experiments have shown, this also works when the parent bird is replaced by a dummy made of paper. Apparently, the nervous signals in the young birds in no way convey the information of seeing a dummy (or the genuine parent bird it substitutes). One can argue that the cognitive system is in a *Matrix*-like (or, philosophically speaking, brain-in-a-vat) situation, as it has no independent reference to what has caused the incoming electro-chemical signals. With Humberto Maturana and Francisco Varela,[38] we can compare the situation of the cognitive system with that of the navigator in a submarine. He avoids reefs and other obstacles without looking even once through the portholes of the vessel (which corresponds to the alleged scientific verification with an absolute reality). All he needs to do is maintain a certain (dynamic) relationship between levers (*i.e.* carrying out experiments) and gauges (*i.e.* reading results).

Radical Constructivism (*e.g.* Glasersfeld[39]) is the conceptual framework that builds on this insight. According to the *Radical Constructivist Postulate*,[40] the cognitive system (mind) is organisationally closed. It necessarily interacts only with its own states. Or, as Terry Winograd and Fernando Flores put it,[41] the nervous system is "a closed network of interacting neurons such that any change in the state of relative activity of a collection of neurons leads to a change in the state of relative activity of other or the same collection of neurons". Cognition is, therefore, a continuously self-transforming activity. There is no purpose attached to this dynamics, no goals imposed from the outside relative to the cognitive apparatus. It is also in line with the *dreaming-machine argument* of Rudolfo Llinás.[42] Since the nervous system is able to generate sensory experiences of any type, we are facing the fact that "we are basically dreaming machines that construct virtual models of the real world". His closed-system

hypothesis argues that the mind is primarily a self-activating system, "one whose organization is geared toward the generation of intrinsic images". The global picture is that cognition acts independently of the environment. It merely requests confirmation for its ongoing dynamical functioning and works autonomously otherwise: "although the brain may use the senses to take in the richness of the world, it is not limited by those senses; it is capable of doing what it does without any sensory input whatsoever".

Evidently, in closed systems, "meaning" cannot refer to a mapping between external states of affairs and cognitive structures. Following Ernst von Glasersfeld's characterisation of RC, meaning must not be considered to be passively received but rather to be actively built up by the cognising subject as the "function of cognition is adaptive and serves the organization of the experiential world, not the discovery of ontological reality".[43] Thus, the emphasis is placed on mechanisms of knowledge construction in humans, and on the fact that cognitive systems actively construct their world rather than being passively flooded by information from the outside. Consequently, "meaning" is a construct. It does not reside somewhere else and is not independent of the scientist who generates it embedded within her worldview.

RC leads to an alternative understanding of knowledge that refrains from assuming that differently constructed worldviews gradually converge towards a knowledge system that ultimately represents the "objective world". Glasersfeld emphasises the necessarily complete ("radical" in the sense of "thoroughly consistent") character of the constructivist endeavour.

> "Those who merely speak of the construction of knowledge, but do not explicitly give up the notion that our conceptual constructions can or should in some way represent an independent, objective reality, are still caught up in the traditional theory of knowledge."[44]

Therefore, the co-ordination among scientists that subscribe to a particular interdisciplinary endeavour cannot be adjusted to an "objective" goal, since its definition would require the recursion to a cognitively inaccessible absolute reality. Instead, discipline-specific goals retain their full applicability as they are formulated with regard to the coherent and consistent knowledge structure of the respective discipline. The process of co-ordination becomes that of "*structural coupling*".[45] In general terms, the structure of a system changes as a result of both its internal dynamics and its interactions with other systems, including its environment. This applies to systems that can change their structure without losing their identity,

e.g. living systems but also scientific communities. Of the latter it could be said that it is indeed their goal to change, *i.e.* evolve with regard to knowledge structures, while staying the same discipline. For such systems there are only two options. Either they manage to plastically change their internal relations among constituent components in such a way that no dynamics harms them, or they are crushed under the influence (perturbations) of their environment and vanish. If two such plastic systems meet and they both manage to change their respective structural make-ups such that each of them generates appropriate changes of state triggered by the perturbations of the other system, they will change congruently and, consequently, undergo structural coupling. It is important to stress that this form of mutual adaptation is not specified by the other system (or environment) in the sense that the other system determines the changes that have to be carried out in order to undergo successful coupling. In this perspective, interdisciplinarity is the structural coupling between participating disciplines such that their identity is preserved but plastic "interfaces" are created that enable the exchange of "knowledge". However, not knowledge *structures* are exchanged (the structure remains private to the respective discipline) but rather perturbations are generated that trigger appropriate changes of state ("orienting action") in the fellow scientist.

In how far do these insights affect interdisciplinary practice? The fact that meaning is not transmitted as an "entity" hampers in particular the "exchange of information" among disciplines. It is not in the words, gestures, symbols with which we express ourselves to others. Rather, communication means re-construction. Language is to be seen as a behavioural system that triggers orienting actions within the cognitive domain of the interlocutor. Thus language is an ongoing process of interpretation and mutual adaptation. As Glasersfeld puts it, to "find a fit simply means *not* to notice any discrepancies".[46] This is in contrast to *matching* something against something else; there are no ways to validate a "correct match". Linguistic co-ordination among participants of an interdisciplinary project has thus to be *viable* in the above sense of fitting.

What will facilitate the process of communication is an attitude of *openness* and expectation to making discoveries. This openness is basically a willingness to extend one's own horizon by accepting the new. It is the opposite of a "haughty" attitude — characterised by the position we take when we think "we know already", when we regard our views as superior and expect nothing enlightening to come. Holding on to the claim that a mind-independent reality plays the ultimate arbiter when it comes to judge

our theories in an interdisciplinary environment does nothing but foster such attitudes. Too seducing is the temptation to turn it into a claim of authority. Instead, we should proceed with the realisation of the contingency and contextual dependence of our own views and a readiness to revise them and improve on them.

There are also impacts on scientific inquiry in general. First of all, the alternative perspective means liberation from the usually lopsided application of methodology, *i.e.* a willingness to go for many different ways of approaching a phenomenon of interest. Secondly, the constructivist approach to scientific inquiry means increased emphasis on the methodological aspects, such as consistency and coherence of our models. That is, rather than try and close the gaps between our models and "reality" in the Popperian sense we should aim to fill up the holes in the patchwork of theories and models and increase its coherence and consistency.

7. Conclusion

The central goal of this essay is to make researchers aware of the current limitations of interdisciplinarity, such as the cognitive shortcomings of participating scientists. I started with two basic questions: "Why do we need interdisciplinary research?" and "What are the problems and possible solutions?" In order to address both points, I first identified methodological and epistemological issues at the core of interdisciplinarity. The former emphasises the fact that interdisciplinarity means open inquiry in order to avoid the usual blinkers of disciplinary research. Unfortunately, the human mind is susceptible to "it ain't broken so don't fix it" canalisations so that we quickly get caught in ignorance and denial of other approaches that might turn out much more fruitful. The latter issue refers to setting up scientific worldviews, *i.e.* the problem of fusing experiences from a variety of sources. I then turned to typical problems of existing interdisciplinary practice. They encompass mutual information deficits (*i.e.* ignorance of the details of other disciplines involved), divergence of terminology (*i.e.* even if you wanted to overcome the information deficit you would encounter the problem of understanding the others' jargon) and various differences among scientific disciplines. These divergent aspects include a number of contrasts, including emphasis on prediction (hard sciences) vs. explanation (humanities), basic vs. applied sciences, and single vs. group efforts. An interesting aspect of interdisciplinarity arises from the phenomenon of black-boxing, *i.e.* when entire fact compounds or procedures are turned into unques-

tioned single facts. I predicted that this would ultimately lead to various stages of interdisciplinarity. Such stages can be identified in the literature. The spectrum goes from loosely coupled multidisciplinarity to transdisciplinarity, where borders between disciplines fade away. As an intermediary conclusion, I claimed that interdisciplinarity can be regarded as the attempt to avoid the sub-ordination of disciplines to a prevalent discipline, which otherwise would result in scientific reductionism. Subsequently, I offered a reflection on these initial questions and the ensuing conceptual reviews from the radical constructivist perspective.

This perspective can be characterised as the insight that the starting point of our scientific endeavour is not reality but our experiences. It is from these that we construct our world, which leads to the epistemological issue of worldview generation. A central aspect of RC, assembling various experiences into a coherent whole, secures the distinct position of science in society, but at the same time does not warrant an exclusive authority claim: "I would be contradicting one of the basic principles of my own theory if I were to claim that the constructivist approach proved a *true* description of an *objective* state of affairs".[46] RC is aware of the fact that it must remain self-applicable. In other words, from an RC perspective, formulating (biological, mathematical, ... constructivist) hypotheses has the same purpose as Wittgenstein specified: to recognise relationships and to find coherent connecting pieces.

The alternative radical constructivist perspective results in five suggestions and implications for interdisciplinary practice. (1) The verbal coordination among participants of an interdisciplinary project has to be viable rather than absolute. This follows from the radical constructivist perspective of knowledge, according to which knowledge is a system-relative and system-related cognitive process rather than a representation or mapping of an objective world onto subjective cognitive structures.[47] Language, therefore, is a process that triggers orienting actions in scientific peers rather than denoting absolute entities and events. (2) Lopsided application of single methodologies should be avoided such that a plurality of approaches becomes possible. (3) Consistence and coherence should be maximised rather than anchoring theories in "reality". They fill up gaps in the scientist's constructive cognitive patchwork. (4) The concept of cognitive canalisation has implications for science education. It may be disadvantageous to create curricula that focus on a narrow domain at an early stage, as this may prevent the student from building up "interdisciplinary habits". This is not at odds with the demand that interdisciplinary researchers "must

at first develop outstanding excellence in their own field".[23] Rather, in order to overcome the weakness of common sense reasoning it is necessary to develop profound knowledge in an auxiliary (formal) discipline such as mathematics or computer science. This warrants the independent status of scientific thinking by introducing a layer of abstraction/detachment between scientific and common sense reasoning. The layer will create the flexibility necessary to escape the canalisations of a single (sub-) discipline. (5) We should proceed with the realisation of the contingency and contextual dependence of our own views and a readiness to revise them and improve on them. Or as Konrad Lorenz once put it "it is a good morning exercise for a research scientist to discard a pet hypothesis every morning before breakfast".[48]

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THE CHATTON–OCKHAM STRATEGY; AN ALTERNATIVE TO THE SIMPLICITY PRINCIPLE

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Modern science has been thoroughly influenced by the centuries-old Simplicity Principle, also known as Ockham's Razor. This principle is usually formulated as "entities must not be multiplied without necessity". The main problem with this formulation is that the necessity or redundancy of an entity (e.g. a concept, hypothesis, law, rule, an explanatory element) cannot always be compellingly demonstrated. This means that, certainly within an empiristic, positivistic or materialistic worldview, the use of Ockham's Razor easily tends towards unjustified reductionism. However, ontologically or epistemologically, the Simplicity Principle can no longer be justified. The Simplicity Principle does not provide a sufficient argument to reject "entities" as irrelevant or superfluous. Moreover, a reductionistic conception of science cannot contribute to tackling issues concerning ultimate values, meanings of life, metaphysics, aesthetics, religion and several aspects of practical life, such as counselling, morals, politics and jurisdiction. Therefore, this article proposes an alternative principle that I have called the Chatton–Ockham Strategy, which is an integration of Chatton's anti-Razor and Ockham's Razor and deals with the complexity–simplicity polarity.

Keywords: theory of science, epistemology, methodology, simplicity, parsimony, elegance, complexity, nominalism, operationalism, reductionism, Ockham's Razor, positivism, hermeneutics, modernist science, history of psychology, dialogue

1. A Personal Introduction to the Problem

When I received my Master's degree in psychology at the Catholic University of Nijmegen, The Netherlands, in 1973, mathematical psychology comprised social statistics and other mathematical research methods and techniques, as well as mathematically formulated theories, such as mathematical learning theories, decision and choice theories. At the time, I felt

that to work on these subjects was indeed scientific work. Hence, I admired the professors of mathematical psychology, Thom Bezembinder and Edward Roskam. Their longing for compelling argumentation, their aversion to vagueness and verbalisms, their love of parsimony and elegance of theory and method, appealed to me. Moreover, I was also pleased with their revolutionary spirit. They were of the opinion that the scientific quality of psychology was insufficient. Something had to be radically altered. For instance, operationalism, which dominated empirical research in psychology, should be abolished.[1–4]

The American physicist Bridgman was one of the founders of operationalism. He wrote: "In general we mean by any concept nothing more than a set of operations; the concept is synonymous with the corresponding set of operations".[5] This operationalism, which developed independently from European logical positivism as well as American behaviourism, was eagerly incorporated by the behaviourists. Concepts, such as intelligence, achievement motivation, fear of failure, mental attitude and group cohesion should be operationally defined. An operational definition of a concept (e.g. intelligence) replaces that concept by observables (e.g. questionnaire items, which can be rightly solved or not) and a procedure (e.g. an algorithm to determine an IQ-score) so that intersubjective agreement can be guaranteed. Aspects of the meaning of a concept, which could not be operationalised, were shaved off and ignored. However, in the social and behavioural sciences, including psychology, operationalism was generally not carried through as radically. Empirical variables that would operationalise a concept, e.g. fear of failure, should represent the pre-existing meaning aspects of that concept as much as possible. Adequate operationalisation of a concept required conceptual analysis. In other words, an operational definition of a concept should have construct-validity.

The mathematical psychologists Bezembinder and Roskam raised three objections to operationalism as carried through in the social and behavioural sciences. The first objection was that operationalism accentuates the importance of isolated concepts and isolated empirical variables at the expense of relations between variables, structures and systems which were considered to be of far greater importance to theory building. The philosopher of science Braithwaite and others supported this objection.[6] Bezembinder and Roskam regretted that Bridgman's operationalism was mainly interpreted as a sort of conceptual operationalism. Operationalism followed the economy principle as much as it eliminated metaphysical and other vague concepts, which cannot be operationalised. However, because

of the neglect of relations, structures and systems, this operationalism can be considered too parsimonious at the same time. The second objection was a lack of economy in another respect. The synonymy between a concept and its operationalisation implies that different operationalisations of the original concept represent just as many different concepts. Thus, conceptual operationalism implies that the original concept is split up into more concepts. In other words, shaving off meaning aspects by operationalisation paradoxically leads to an abundance of concepts in stead of an economy of concepts. The third objection concerns the linkage between psychology as a science and everyday life, ordinary language and common sense. From the start conceptual operationalism depends on existing ordinary concepts which are embedded in everyday life and common sense. This is especially the case with the reception of Bridgman's operationalism by social and behavioural scientists.

Bezembinder and Roskam considered this linkage with ordinary language and common sense superfluous and even distorting. Therefore, the development of a truly scientific psychology should not be founded on everyday knowledge, ordinary language and common sense, which could at best have a heuristic meaning. Bezembinder and Roskam were of the opinion that the removal of these objections could be accomplished by mathematical modelling. Mathematical models should be connected with observations and empirical variables without mediation of everyday concepts. Their main goal was to formulate exact nomological networks and to promote a formalised theoretical psychology.[4] In this way, mathematical psychologists invariably dispensed with attributing meaning to and making sense of human existence, as personal, social or cultural. I must admit that Bezembinder and Roskam did realise that the problem associated with their programme was how to obtain relevance to everyday life. However, they thought, over-optimistically, that this was a problem that could be solved later on. I did not feel at ease anymore with the reductionistic implications of the aims of elegance, parsimony, economy or simplicity. Human and social life is intrinsically interwoven with ordinary language. So it appears very risky to abstract from it, I thought.

Nowadays, formal logic and mathematisation have shown to be of little importance to practical problems concerning politics, law, ethics, aesthetics, philosophy of life, everyday human understanding, choices and decisions. Therefore, some logicians, linguists and philosophers work on argumentation theory, using ordinary language again. In addition, qualitative empirical research methods have become more valued in the human and so-

cial sciences. The logic of qualitative inquiry is informal. However, I realise only too well that the price of practical relevance is a loss of compellingness of reasoning.

I graduated with a minor in philosophical psychology, phenomenological anthropology in particular. Initially, I had no problem with the combination of mathematical psychology and phenomenological anthropology, partly because I agreed with Stephan Strasser, professor of phenomenology. He was of the opinion that phenomenology, including hermeneutic and dialogical phenomenology, was but a type of philosophy of science, a meta-theoretical interpretation of the social and behavioural sciences and not an alternative methodology.[7,8] He thought that an empirical phenomenology could readily degenerate into a sort of phenomenological impressionism, in which case phenomenological research would be dismissed as not scientific. At present, however, I beg to differ with him. The phenomenological tradition can be considered one of the main sources of qualitative methodology, which has been far more developed and recognised since his time.

From 1973 until 1990, I worked at the State University of Leiden, in the department of Methods and Techniques of Psychological Research. In this department, the "model tradition" was also more dominant than the "operationalisation tradition".[9] I began to specialise in qualitative methodology as a result of my growing scepticism regarding both traditions and because graduate students in social psychology requested me to teach qualitative research methods and philosophy of science. Qualitative research does not abstract from everyday life, ordinary language or common sense. The subject of my doctoral dissertation was "methodological objectivity and qualitative research".[10]

A substantial problem that still remains is how to combine mathematical and qualitative research methods and techniques in such a way that their strengths are maximised and their weaknesses minimised. However, in this essay I will concentrate on the Simplicity Principle, which is associated with the idea of Elegance. I have shown that both the "operationalisation tradition" and the "model tradition" are thoroughly influenced by this principle. The same is true for modernist science as a whole. How did this happen and why? Which revisions or alternatives can be proposed?

Therefore, my questions are: What is the origin and meaning of the Simplicity Principle? What is its justification? What are its drawbacks? Which alternatives, if any, have been formulated? And my goal is to choose or to develop a satisfying alternative.

2. The Historical Origins of the Simplicity Principle

I consider the Simplicity Principle to include the Law of Parsimony, the Economy Principle, the axiom of minimal number of principles and the principle of minimal plurality of assumptions, hypotheses, rules or laws. The Simplicity Principle became famous as Ockham's Razor (sometimes written Occam's Razor). In the writings of William of Ockham (c. 1285–1347) the Simplicity Principle plays an important part, but the principle was also well known to other medieval theologians and philosophers. Moreover, they knew that this very principle was explicitly discussed by the Greek philosopher Aristotle (384–322) in several of his writings. According to Derkse,[11] almost all the varieties of meaning of the Simplicity Principle were present in Aristotle's writings and these meanings continued to exist throughout Western history. The most important facets of meaning already present in Aristotle's work are:

- ontological simplicity; things, events, processes, nature and the cosmos are considered to be simple by themselves; superfluity does not exist in the cosmos (Ockham, Leibniz and others believed that God has created the universe as something simple)
- epistemological simplicity; because nature and the cosmos are simple, nature and the cosmos can be understood and this understanding can be based on simple principles
- methodological simplicity; one has to search for a minimum of explanatory elements; one has to select the most economical and shortest argumentation (Aristotle also discussed a principle which is nowadays known as the *ceteris paribus* condition: choose from two options the more simple one provided that these options are equivalent in all other respects); methodological simplicity, including the selection of simple methods and techniques, may be differently motivated: ontological, epistemological and cheer methodological (think of reliability and validity, *etc.*) motives, but also pragmatic or axiological (notably aesthetic) reasons may be given, as indicated below
- pragmatic simplicity; the selection of the simpler option is motivated by heuristic reasons or by easiness of management (easiness of learning something, understanding something or remembering something; transferability)
- axiological simplicity; the selection of the simpler option is motivated by norms and values; one may differentiate between two

cases: (a) simplicity as a value or a virtue by itself; the search for simplicity may intrinsically produce mental satisfaction, (b) aesthetic simplicity; the simplicity of things, the knowledge and experience of that which implies an aesthetic or even erotic delight; simplicity is good because it is beautiful (indeed, Cicero conceived simplicity as an ingredient of elegance)

In fact, the Simplicity Principle is even older than the writings of Aristotle. The Melisian philosophers of nature (c. 600–520) already postulated one substratum from which all substances, which compose the cosmos, were derived.[12] Pythagoras (c. 580–500) and Plato (427–347) mentioned the idea of a minimal plurality of principles, hypotheses and laws. Aristotle, however, formulated the Simplicity Principle the most explicitly and extensively. Today, even more meaning aspects are discussed. That is why Bunge chooses as the title of his overview "The complexity of simplicity",[13] but not all differentiations are relevant to my argument.

To the Roman orator Cicero (106–43), elegance is the most encompassing virtue. To him elegance implies simplicity. A person who can be said to possess the virtue of elegance, shows competence concerning several issues, such as: showing good manners, a sophisticated style of speaking, precision in linguistic usage, being well-informed, having philosophical knowledge and insight, artistic inclination, subtlety of reasoning and the right way of posing a problem and solving it. This competence is always combined with refinement, good taste, sureness of choice and rightness of choice. In addition, this way of life includes a sort of simplicity, *viz.* avoidance of superfluity, redundant decoration, luxury and frills. To Cicero, elegance is a characteristic of a life-style as well as a feature of a theory or an aspect of a theory. An elegant theory is a simple theory. On behalf of elegance, a philosopher or a scientist should choose the simplest explanation that is still adequate. Thus, the ability of choosing rightly is connected with simplicity and adequacy, not too much and not too little.[11] The ontological meaning aspect of elegance or simplicity seems to be present in the thinking of Cicero as well. One of his maxims was "*Simplex ratio veritatis*" (simplicity is the measure of truth, or, simplicity is the nature of reality). Robert Grosseteste (c. 1168–1253), an early scholastic philosopher, also associated simplicity with elegance and aesthetics. He made use of mathematical methods to come to this realisation. Strangely enough, Ockham, who has given his name to "Ockham's Razor" as a metaphor of the Simplicity Principle, did not discuss elegance or aesthetics in relation with simplicity.

The Simplicity Principle or the Law of Parsimony was well known and recognised in medieval philosophy, especially scholasticism (c. 500–1400), within which one of the main disputes concerned realism versus nominalism. Both the realists (who, including Thomas Aquinas, said that universal concepts, for example, man, animal, redness and goodness, refer to entities which really exist, independently of our thought) and the nominalists (who said, like William of Ockham, that universal concepts are just names of collections of individuals and did not refer to independently existing entities) recognised the Simplicity Principle. The difference of opinion concerned the questions whether and why a concept is or is not superfluous and whether and why an explanatory element is or is not necessary. The interpretation and usage of the Simplicity Principle in behaviourism, operationalism, logical positivism and modernist science as a whole is more similar to the nominalistic approach than to the realistic approach.

The Simplicity Principle is a very ancient idea. However, simplicity as discussed so far is an idea that can never be a sufficient argument to shave off elements, such as conceptual and explanatory elements, in a philosophical or scientific context. Additional arguments concerning the superfluity of these elements are necessary. After all, for which reasons should an element be judged as superfluous? I will deal with this question in the following.

3. Ockham's Razor

The nominalist William of Ockham (c. 1285–1347) applied the Simplicity Principle more radically than the realists did, even more radically than other nominalists, such as John Duns Scotus (c. 1265–1308). Ockham used this very principle, explicitly or implicitly, with regard to almost all the subjects he discussed. Even his theology contains some traces of the Simplicity Principle. In his opinion, God has the power, by a pure act of will, without any help or mediation, to create directly whatever he wants to exist. God is also able to be in direct contact with his creatures. God's omnipotence is only limited by the logical principle of non-contradiction.[14] God has the power to create whatever he wishes, including superfluous entities, although he would not do that, but he cannot create logical contradictories. Whether God actually did create redundancies is beyond man's ability to know with certainty. Ockham was of the opinion that we cannot have such knowledge. He considered the omnipotence of God rationally not explainable. Religious belief is a mystery and all created entities are ultimately contingent. This split between religious belief and reason distinguishes Ockham

from Thomas Aquinas (1225–1247). Whereas the Dominican and realist Thomas Aquinas tried to present Christian Faith as rationally justifiable, the Franciscan and nominalist William of Ockham said that Christian faith was to be accepted as rationally not justifiable. Ockham's opinion did not at all prevent him from being a true believer, but it led to conflicts with the Pope. Derkse writes that Ockham was even excommunicated.[11]

Ockham's Razor has often been formulated as follows: "*Entia non sunt multiplicanda sine necessitate*" (entities should not be multiplied without necessity). It seems, however, that Ockham did not use this formulation. He did use the following formulations: "*Frusta fit per plura, quod potest fieri per pauciora*" (it is vain to do with more what can be done with less; in context, what can be explained by the assumption of fewer things is vainly explained by the assumption of more things) and "*Pluralitas nunquam ponenda est sine necessitate*" (a plurality should never be posited without necessity). In later writings, Ockham also said "When a proposition is verified of things, if two things suffice for its truth, it is superfluous to posit a third".[14] The latter formulation was probably a reaction to the critical comments of Walter of Chatton (see section 6).

Ockham indicated and used three criteria for judging the necessity of positing items. Plurality should not be assumed unless reason, experience or an infallible authority is convincing. Reason refers to immediate logical insight or logical deduction. Experience authority refers to Christian revelation as expressed in Scripture or the writings of the Church Fathers;[14,15] sometimes "the Roman Church" is mentioned.[16] In the seventeenth century, the Jesuit philosopher Honoré Fabri said that the principle "entities should not be multiplied without necessity" does not make any sense, unless it means "entities should not be multiplied without reason or experience". Except for the infallible authorities, this condition is totally in harmony with Ockham's ideas. Hence, Fabri's condition seems to be superfluous. Ockham even specified how reason and experience should be conceived.

Relations, including causal relations, movement, action, change, growth *et cetera*, do not have an independent existence. Ockham was of the opinion that these concepts only exist in our mind. However, Ockham did not reject metaphysics or theology. He was a medieval Christian believer. The idea that Ockham's Razor implies a rejection of all sorts of metaphysics is characteristic of its interpretation in twentieth-century logical positivism.[17] Formalised logic in logical positivism is more restrictive than Ockham's logic. In addition, the concept of experience in logical positivism is more limited; it means sensory perception in which attributing meaning is

reduced to a minimum to guarantee intersubjective agreement between observers. Moreover, I think that the Christian infallible authority has been replaced by secular authorities in our contemporary world, such as evaluation committees. In as far as logical positivism thoroughly influenced modernist science, it can be said that Ockham's Razor also characterises modernist science, albeit in a restricted and limited version. Historically, Ockham influenced logical positivism through empiricism.

Originally, Ockham's Razor had an ontological meaning as well. As a nominalist, Ockham rejected the independent existence of universal concepts as superfluous. Furthermore, he accepted not only reason and experience, but also an infallible authority (Scripture or the Church Fathers) as a criterion to evaluate the superfluity or necessity of an entity. However, he separated Christian belief and revelation from rationality and scientific knowledge. As a consequence, the Simplicity Principle of Ockham has, besides an ontological meaning, an epistemological as well as a methodological significance. With regard to scientific knowledge, the criteria to judge superfluity or necessity are reason and experience. Except for his metaphysics, theology and the idea of revealed knowledge, Ockham was a predecessor of the English empiricists, such as: Francis Bacon, John Locke, George Berkeley and David Hume. However, in empiricism the Simplicity Principle can only be a mental idea without ontological meaning, because the empiricists believed that nothing could be known beyond our senses and ideas, which are derived from sensory perception. Any reality outside our senses and our own mind could not be known. Empiricism is not a necessary implication of the Simplicity Principle or Ockham's Razor as such. Empiricism dictates a certain interpretation and use of it. The same is true regarding Immanuel Kant (1724–1804), who synthesised rationalism and empiricism. Kant accepted the usual formulation of Ockham's Razor at the time: "entities are not to be multiplied beyond necessity". However, he conceived Ockham's Razor not as a rule about nature itself, but as a regulative idea of pure reason, its function being to bring unity into the body of our detailed knowledge.[14] To Kant, the Simplicity Principle had a purely epistemological and methodological meaning.

I realise that several books on the methodology of the social and the behavioural sciences say that science is founded on reasoning, especially formalised logic, and observing, especially deliberate sensory perception (see for instance Kruyer[18]). The echo of Ockham's voice may be noticed here. At the same time, I realise that the Simplicity Principle, including the original version of Ockham's Razor, is not only one of the causes of

empiricism, logical positivism and scientific modernism, but also receives its reductionistic meaning and use from these approaches.

4. Unjustifiable and Regrettable Reductionism in Modern Science

The mixture of ontological, epistemological and methodological facets of meaning of the Simplicity Principle may be found throughout Western history of philosophy and science.[11] For instance, the physicist Isaac Newton (1643–1727) also combined these meaning facets. In Newton, nature is considered to be simple. Superfluous causes do not exist. Because nature is simple, nature can be understood and explained. Therefore, one has to strive for a minimal number of assumptions, hypotheses and rules. Gottlieb Wilhelm Leibniz (1646–1716), who discovered the infinitesimal calculus simultaneously with Isaac Newton, was convinced that the Supreme Being does not create anything superfluous or remotely resembling disorder. Indeed, one cannot even conceive of any haphazard occurrence in the universe. More emphatically than any other rationalist philosopher either before or after him, Leibniz propagated that the Simplicity Principle prevails throughout the real world. Leibniz attempted to prove that this world of ours is the best of all possible worlds, exhibiting the greatest simplicity in its premises and the greatest wealth in its phenomena. Conforming to this metaphysical tenet, he advocated an analogous simplicity in our interpretation of nature. Therefore, like Ockham, he demanded that we abhor unnecessary multiplicity of suppositions.[12]

In the writings of the physicist Pierre Maupertuis (1698–1759), the metaphysical and theological meaning facets were carried to an extreme. He formulated a minimisation principle (nature chooses the most economical path to follow by moving bodies) and he claimed that this principle would imply a proof of the existence of God.[12] Maupertuis's attempt to reconcile reason with religious belief is rather Thomistic. In this respect, Maupertuis differs strongly from the nominalist Ockham. It is clear that the logical positivists, who tried to eliminate any trace of metaphysics, selected Ockham's Razor as their favourite version of the Simplicity Principle,[17] because of Ockham's nominalism. Ockham's nominalistic version of the Simplicity Principle could be far more easily developed into a more reductionistic version.

The mixture of ontological, epistemological and methodological meaning facets is sometimes unclear or less explicit. The physician Hermann Boer-

haave (1668–1738) cherished the motto "*simplex sigillum veri*" (simplicity is the feature of truth). Boerhaave's motto is very similar to the maxim of Cicero, "*simplex ratio veritatis*", and it may contain several meaning facets already differentiated by Aristotle, possibly even an aesthetic one. This is certainly the case with Albert Einstein (1879–1955). He subscribed to the maxim of Cicero, who conceived simplicity as an ingredient of elegance. To Einstein, the Simplicity Principle is mainly an ontological principle. Because of its ontological significance, simplicity was also a sign of validity, meaning an heuristic and methodological principle and the way to reach unification of theories.[11] However, the biographer Pais (1983) is of the opinion that Einstein was increasingly hindered by his growing ontological and aesthetic fascination for the Simplicity Principle.[19] Einstein did not succeed in formulating a unifying theory.

The Simplicity Principle as discussed so far shows a lack of clarity. Which criteria for superfluity or for necessity are acceptable? Which experiences or perceptions are reliable or relevant? What type of reasoning is relevant or strong? Does simplicity have mainly a pragmatic, methodological and aesthetic significance or mainly an ontological (including a metaphysical or theological) significance? What are the relations between the ontological motive, the methodological motive and the aesthetic motive? *Et cetera.* This lack of clarity has opened the door to the development of one-sided conceptions of Ockham's Razor. A case in point is Morgan's Canon, a version of the Principle of Parsimony, by the comparative psychologist Lloyd Morgan (1852–1936). Morgan said that one might never interpret an action as the outcome of the exercise of a higher psychical faculty, if it can be interpreted as the outcome of one that stands lower in the psychological scale. The problem, not discussed by Morgan, is that an interpretation of an action depends on a theoretical framework. Thus, the validity of the proposition that an action can be interpreted as an outcome of the exercise of a lower psychical faculty depends on the trustworthiness of that theoretical framework. Theoretical frameworks are fallible. Hence, an absolutely neutral or objective criterion does not exist. That is why a principle such as Morgan's Canon brings about a precarious reductionism. Scientific psychology has been influenced by such regulative ideas for decades.

Within the frameworks of materialism, physicalism, behaviourism and operationalism, Ockham's Razor has received a very reductionistic interpretation. Several psychical, mental and spiritual issues and also norms, values and existential concerns are banished from the scientific domain, because

these phenomena would be explicably superfluous or else not subject to scientific research. In the course of history, the opinions on the superfluity or scientific senselessness of things have been thoroughly determined by materialistic, physicalistic, behaviouristic and operationalistic presuppositions, which are not only of a methodological nature, but also imply a reductionistic idea of reality. In other words, these presuppositions have ontological implications. Concentrating too much on sharpening one's razor obstructs one's view of reality.

The Simplicity Principle as an explicit requisite for scientific theories prevails in the empirical-analytical view of science. This view is mainly a product of logical positivism and critical rationalism. I already mentioned the cheerful and reductionistic reception of Ockham's Razor by the logical positivists; all "metaphysical" elements of scientific language were shaved off. Several logical positivists subscribed to conceptual instrumentalism. Theoretical concepts or constructs do not refer to independently existing entities, but are to be considered as sheer instruments to bring order into our thinking. Conceptual instrumentalism can easily be recognised as a version of Ockham's nominalism. Bertrand Russell (1872–1970), not a logical positivist in a strict sense, although closely related to that view, was of the opinion that Ockham's Razor should be used to eliminate the ontological interpretation of theoretical constructs. The existence of substances and substrates should not necessarily be denied, but it is much more useful to ignore them. Theoretical constructs should be conceived as "logical constructs".[20] Russell and most logical positivists agreed upon the view that metaphysical and ontological presuppositions are superfluous, because these presuppositions could not rationally or empirically be justified.

I must admit that within the empirical-analytical tradition some milder interpretations of the Simplicity Principle may be found. For example, the logical positivist Hans Reichenbach (1891–1953), who became famous for his differentiation between the context of discovery and the context of justification, accepted only inductive simplicity. An inductive-statistical theory obtains simplicity by using so-called best-fitting curves to make better predictions possible. He wanted predictive power, not simplicity or elegance as such.[21] The critical rationalist Karl Popper (1902–1994) said that the Simplicity Principle as a distinct principle is superfluous, because simplicity is implicated by his falsification principle. Falsifiability of theories requires simplicity.[22] However, both Reichenbach's inductivism and Popper's falsificationism are, in a sense, still reductionistic. Predictive power and falsifiability cannot be the only criteria for scientific theories. First, these two

criteria differ from each other. Second, other criteria are equally important, such as: degree of corroboration, explanatory power, empirical content, scope, fruitfulness and practical relevance. Third, internal problems arise within the contexts of prediction and falsification. Hempel extensively discusses Reichenbach's and Popper's conceptions of simplicity.[23] He points to several inconsistencies, which require too much room to explain here. His general conclusion is that the problems associated with constructing a precise formulation and a uniform justification of the Simplicity Principle are not yet solved.

The scientific and methodological significance of the Simplicity Principle should not be overestimated. Simplicity as a norm of scientific quality is only recognised within the empirical-analytical tradition. Within the hermeneutical-interpretative tradition in the social and behavioural sciences and the humanities, simplicity is not posed as a separate norm. Rather, complexity is a norm. A hermeneutical interpretation should do justice to all the elements of a text, a narrative, a biography, *et cetera.* For this reason and because of other differences, the adherents of the empirical-analytical approach do not take the hermeneutical-interpretative approach very seriously. Hermeneutical-interpretative and also critical (neo-Marxist or otherwise) approaches belong to the collection of regrettable victims of Ockham's Razor. Regrettable, because the justification of the use of Ockham's Razor is doubtful.

Ockham's Razor is mostly justified by assuming the superfluity of something on the basis of reason or experience. In fact, however, the assumption of this superfluity often cannot be rationally or empirically justified. The assumption of redundancy is often based on ontological presuppositions or even prejudices. The assumption is that certain ontological ingredients are not necessary and can be eliminated. To justify this amputation by referring to Ockham's Razor would yield circularity. In other words, justifying the elimination of entities by referring to Ockham's Razor is very often a *petitio principii.* This means, that Ockham's Razor as an argument is often a cover-up for an implicit ontological stance or prejudice. The Simplicity Principle, as much as it seems to present a criterion, rather presents a problem. The problem is how to answer the question why something is superfluous or necessary. This problem should not be solved too easily by relying on doubtful assumptions. Today, we should be prepared to envisage complexity. As we have seen, in modernist science, reason and experience as criteria for using Ockham's Razor are reduced to symbolic logic, mathematisation, sensory perception, systematic observation and operationalisation.

These reductions of reason and experience make the use of Ockham's Razor even more unjustified. Did Ockham's third criterion, infallible authority, simply vanish? No, I don't think so. The infallible authority has not been eliminated, but it has been reduced to editorial boards, subsidisers, supervisors, evaluation committees, and, of course, Kuhnian paradigms, disciplinary matrices or priests of scientific communities or bureaucratisation of the scientific enterprise. Sometimes these institutions and persons behave and are treated as if they were infallible. However, they are not. In sum, Ockham's Razor, including the three criteria for necessity or superfluity (reason, experience and infallible authority) can be easily recognised in modernist, empirical-analytical science, albeit in a reductionistic and often regrettable mode. After all, the modernist application of Ockham's Razor has eliminated metaphysical, spiritual, normative (ethical and aesthetical) as well as several other practical problems of human and social life from the agenda of scientific research. Within modernist science, these issues and concerns might be researched as objects of study, but would not be answerable as genuine questions. Modernist science cannot answer existential questions in principle.

5. Some Revisions of the Simplicity Principle

In our time, there is an increasingly recognition of the complexity of the cosmos, nature, culture, the human mind *et cetera*. Therefore, the ontological argument for the Simplicity Principle — the cosmos, nature *etc.* are simple by themselves — has lost its strength. Methodological developments show that mathematical models for data-analysis have a growing power to analyse more complicated phenomena. For instance, these models can simultaneously manage many qualitative and quantitative data, several variables, which are measured on different levels and a variety of relationships between these variables. Moreover, present-day social and behavioural researchers not only use mathematical methods, but also qualitative research methods.[24] In mathematics, physics and chemistry, so-called complex systems are an important object of study. Cilliers points to a significant difference between complex systems and complicated systems.[25] Complicated systems are analysable in terms of basic elements and relations. A complicated system can be reduced to a simple system or a set of simple systems. A truly complex system cannot be reduced in such a way. Complex systems consist of a large number of elements, which interact in a non-linear manner, so that small causes can have large effects and there are

loops in the interactions. Complex systems are open, not stable, dynamic — they have a history — and self-organising (the notions of "autopoiesis" and "emergence" apply here). Truly complex systems cannot be analysed the way complicated systems can. The execution of the so-called analytical method (splitting the structure of the system and the meaning of that structure, into separate levels, *etc.*) is not adequate anymore. "The success of the analytical method has created the illusion that all phenomena are governed by a set of laws or rules that could be made explicit. The mercenary use of Occam's razor, often early in an investigation, is an indication of this belief".[25] In fact, most real systems are truly complex.[26] In addition, postmodernist philosophers, such as Derrida and Lyotard, indicate that all-embracing theories do not hold anymore. They criticise the modernist neglect of many sorts of differences and the modernist usage of several strategies of social exclusion. Cilliers thinks that postmodernist philosophers call on scientists to work more inclusively and practically, to think more locally, to notice contingencies and to preserve complexities, so that research methods and techniques are no longer chosen too hastily or *a priori*.[25]

Does the Simplicity Principle still have any meaning then? It seems that the Simplicity Principle can only have a pragmatic meaning or an aesthetic meaning. For instance, complicatedness and complexity may be so overwhelming that individuals, societies and cultures are devastated. A certain control seems to be useful to survive, individually, socially and culturally. However, survival requires the acknowledgement of existing complicatedness and complexity. Therefore, the Simplicity Principle still has an ontological ingredient. The core meaning of the Simplicity Principle — one should not posit more than what is necessary — which is inherently present in the conceptions of Aristotle, Cicero, Ockham and others, can still be applied. The rule seems to identify complicated systems and reduce them to what is necessary, and recognise truly complex systems and not reduce them because nothing in them is superfluous. However, it will be difficult to identify each existing entity as a simple system, a complicated system or a complex system. As I see it, this problem seems to be a mere translation of the classical problem of determining whether an entity is superfluous or necessary. Moreover, truly complex systems may be incomprehensible. Humans have limited cognitive capacities. So, "superfluous" may turn out to mean "making something less comprehensible or incomprehensible to the experts" and "necessary" may turn out to mean "making something comprehensible or more comprehensible to the experts".

To avoid both the problem of demonstrating that a system is a truly complex one and the risk of reducing a system unjustly, one might consider the possibility of adding the *ceteris paribus* condition. This means that of two things (theories, hypotheses, concepts *etc.*) the simpler one is chosen provided that these things are equivalent in all other respects. The *ceteris paribus* condition precludes that reductions are carried through to extremes. However, three objections can be raised. First, the *ceteris paribus* condition is rather abstract; in practice, two theories which are equivalent in all respects except for simplicity, rarely occur. Second, the demonstration of the equivalence in all other respects will be very difficult, if not actually impossible. Third, the *ceteris paribus* condition turns the Simplicity Principle into a comparative rule. Hence, the possibility arises that both theories are too simplistic in a deeper, non-comparative sense.

Another interpretation of the *ceteris paribus* condition would be that the more simple theory (or hypothesis, *etc.*) does not exist yet, but has to be constructed from an existing theory in such a way that the theory which already existed and the resulting theory only differ regarding simplicity. However, this is tantamount to the idea that an existing theory has to be reduced without losing necessary aspects. In other words, the *ceteris paribus* condition in this interpretation boils down to a senseless decoration of Ockham's Razor. No problem associated with Ockham's Razor has been solved. We still have to prove which entity is superfluous and which entity is adequate.

The addition of the *ceteris paribus* condition to Ockham's Razor does not really help to avoid regrettable reductionism. In all cases in which the superfluity or necessity of something cannot be proved with certainty, Ockham's Razor will tend to be used in a way that is too reductionistic. Hence, it still seems to be the case, that rather than being a justification, the Simplicity Principle poses a problem. Let us look at some alternatives.

6. Chatton's Anti-Razor and other Counter-principles

For a long time, William of Ockham was intensively engaged in a polemic with Walter of Chatton (c. 1285–1344). Both entered the Franciscan order at an early age. Both were nominalists and both studied and taught at Oxford. Chatton formulated an alternative principle that Maurer characterises as "Chatton's anti-Razor".[14] Chatton formulated his counter-principle as follows: "If three things are not enough to verify an affirmative proposition about things, a fourth must be added, and so on".[14] Another version of

Chatton's anti-Razor was: "When an affirmative proposition is verified of things, if one thing does not suffice to verify the proposition, two things must be posited, and if two things are insufficient then three, and so on to infinity". One could say that Ockham's Razor and Chatton's anti-Razor do not essentially differ. Gedeon Gál suggests that they are but two sides of the same coin, the Razor expressing negatively what the anti-Razor expresses positively. Both Ockham and Chatton require a sufficient number of entities to verify a proposition. Ockham states "no more than is necessary" and Chatton states "no less than is necessary.[11,14] Nevertheless, I am of the opinion that Chatton's anti-Razor is more interesting than the alternative principles of Leibniz and Kant, although these ideas point to the weakness and one-sidedness of Ockham's Razor.

Leibniz thought that the nominalists' Law of Parsimony should be countered with a Principle of Plenitude. However, this principle does not modify Ockham's Razor at all. Leibniz just meant to say that there is simplicity in nature's laws (which are God's means) and plenitude in their effects. In a methodological context, Leibniz's principle is not relevant. Kant thought that Ockham's Razor, which he conceived as a regulative idea of pure reason, should be moderated by a counter-principle, which he stated as follows: "The variety of beings should not rashly be diminished". This principle is a rather mild moderation. The mathematician–philosopher Karl Menger proposed his own anti-Razor, the Law against Miserliness, which is less mild: "Entities must not be reduced to the point of inadequacy".[27] However, these alternatives do not have much surplus value. Cicero already said that simplicity should be counterbalanced by adequacy. Ockham himself formulated criteria for what is necessary (or adequate), such as reason and experience. Ockham never intended to eliminate necessary things. Menger's general formulation of his Law against Miserliness is almost similar to Chatton's anti-Razor: "It is in vain to try to do with fewer what requires more".

An interesting contemporary counter-principle has been proposed by Heron.[28] However, Heron restricts his proposal to the domain of the spiritual, the subtle, the paranormal and extrasensory perception. He says: "My opposite principle is that it is wise to encourage an ambiguous experience to acquire luxurious growth in the direction of the complex and the occult, rather than rigorously cut it down to an awareness of the simple and the obvious. I will call this the principle of Heron's beard".[28] He integrates Ockham's Razor with Heron's Beard by the following guiding combination rule or canon: "Grow the beard before you decide whether or not it is appropriate to use the razor. Don't contract before you ex-

pand your awareness; and only contract it if the expansion results in an obvious nonsense".[29] He elaborates his canon by discussing specific cases in the domain of the subtle, but in every case Heron's Beard precedes Ockham's Razor. Unfortunately, Heron did not integrate this canon with his methodology of co-operative inquiry, which has a more general importance to human research.[29] Furthermore, I don't think that the precedence of Heron's Beard should be compulsory in every thinkable research situation beyond the domain of the subtle and spiritual. Sometimes, the beard may be already there.

It is important to realise that Ockham and Chatton differ, especially methodologically, with regard to their mental attitude, intellectual approach and commitment. The intention is to identify superfluous elements and to eliminate them (Ockham), or, the intention is to identify shortcomings and to give a proposition a sufficient underpinning (Chatton). Within a context of uncertainty, the difference does matter a lot. With respect to attitude, intellectual approach and commitment, the difference is more significant, the more the superfluity or necessity of an element cannot be demonstrated with compelling proof. Ockham and Chatton were engaged in debates on exactly these issues. Ockham was of the opinion that certain entities were superfluous and Chatton was of the opinion that these entities were necessary.[14] For example: Ockham thought that to verify the proposition "A produces B" only two entities were necessary, A and B. Chatton thought that a third entity should be added, a real relation of causality between A and B. Chatton's argument was that otherwise God could have produced both A and B. In this case, A would not be the cause of B. However, Ockham replied that God could also have produced the third entity. In this case, the third entity would only seemingly be a real causal relation. *Et cetera, et cetera.*

7. The Chatton–Ockham Strategy

To formulate a new regulative principle for methodological application, I take the debate between Ockham and Chatton as a point of departure. The principle or rather strategy which I propose, says that, within the context of a critical dialogue, participants have to discuss, with alternating attitudes, concerning which things may be superfluous or necessary, which shortcomings exist and how to deal with them. I call this strategy the Chatton–Ockham Strategy. Simplicity (including economy and parsimony) and complexity (including complicatedness and sufficiency) are to be placed

in a right relation with each other, a dynamic balance. In addition, the discussants, the participants in the critical dialogue, have to realise right relations among themselves, i.e. a dialogical relationship. At the same time, the participants have to internalise this dialogical relationship. They have to develop an internal dialogue. Let us have a closer look.

Such a debate, or critical dialogue, may help to prevent degenerations of Ockham's Razor as well as Chatton's anti-Razor. Possible degenerations of Ockham's Razor are unjust reductionism and regrettable shortcomings. Possible degenerations of Chatton's anti-Razor are progressive additions and unnecessary redundancies. Additionally, the threat of an endless regression associated with Chatton's anti-Razor can also be controlled by a framework, context or field which determines the conditions within which the scientific research is executed. To study the implications of selected conditions, a separate research project may be started. The critical dialogue on superfluous elements, shortcomings and possible implications of the chosen context should not only be based on formal logic and sensory perception, but it may also include informal argumentation, hermeneutical interpretations, narrative analysis, existential and spiritual experiences. Which approach will be the more adequate, depends on the research object, the research problem, the theoretical framework and the critical dialogue about these matters.

A critical dialogue is a conversation or discussion that is critical with respect to the content of what is stated. A critical dialogue also implies a dialogical relationship in which participants strive for openness, interactive symmetry, reciprocal trust and respect.[30,31] The discussion about superfluity and necessity, complexity and simplicity, redundancies and shortcomings should be embedded in a dialogical relationship, because the argumentative quality of this type of discussion cannot be guaranteed by following strict, formalised logical rules or by a mathematical methodology. Argumentative quality requires communicative quality. In addition, the ideas of superfluity and necessity may be discussed themselves. Ideas such as fruitfulness, appropriateness or comprehensibility might be more adequate.

A participant in a critical dialogue should be able to realise an internal critical dialogue, a self-reflexive dialogue. Thus, the critical dialogue has an intersubjective and an intrasubjective meaning. Participants need the mental flexibility to alternate Ockham's attitude with Chatton's attitude to be able to understand other participants. Communication requires the personal ability of role taking.

Hence, the Chatton–Ockham Strategy refers to a threefold relationship.

The first facet of this relationship is substantial. Issues concerning simplicity and complexity are to be considered in relation to each other. The second facet is intersubjective. The argumentative quality of the critical dialogue requires a dialogical relationship that has communicative quality. The third facet is intrasubjective. Individual participants should be mentally able to alternate Ockham's attitude with Chatton's attitude. The participants need to be able to have a flexible, reflexive and critical internal dialogue. Simplicity and complexity, Ockham's Razor and Chatton's anti-Razor (possibly Heron's Beard), self-criticism and open-mindedness, reductionism and openness towards normative, ontological and paranormal issues, reason in relation with sensory experience and intuition, hermeneutical interpretation, existential and spiritual experiences are related to each other in a dialogical synthesis, which should be conceived as an internal and external dynamic process. This process transcends modernist science.

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THE INTRINSIC MULTIPLICITY OF SCIENCE: ITS INTERNAL AND EXTERNAL CONFRONTATIONS — AN ESSAY

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At its core, "science" reveals constancy in basic principles, although in practice it is a multifaceted process. Science changes its face depending on how, by whom and why it is utilised. To confine the definition of science to either "the deepening of the understanding of our universe" or "the mastering of our world and developing of tools for society", would be to oversimplify its actual mechanism. The various stances in science, from "utility inclined" to "philosophically inspired", translate into a multiplicity of legitimate confrontations. Still, intrinsically, its ongoing creative phase makes speculation a prerequisite, accounting for its underlying multiplicity. Finally, basing myself on elementary scientific developments, I will propose arguments for an inclusive ontology.

Keywords: science, world views, intrinsic multiplicity

1. Inside and Outside Perspectives

From my particular point of view — that of an academic physicist involved in interdisciplinary research for several years — I can see the landscape of science unfolding as an intriguing and complex labyrinth comprising both golden bridges, Möbius alleys and gutters. *Prima facie*, science — as it is bannered — is an objective and inductive formalism for understanding, describing and predicting events and processes of our world. In its wake, a record of achievements (and disasters — allegedly "induced by man by error") has given it a halo of the "old and venerable", claiming its legitimacy as "science".[1] This already points out three main elements of science: knowledge, achievement and assessment.

What is the origin of our personal image of science? It depends to a great extent on the contingencies of one's personal vita, which includes the

membership of a particular culture and social group, education and opportunities, places and encounters, and last but not least the experience of the scientific process itself. Between the academically fostered and geographically and culturally isolated, between the comfortably settled and the survival oriented, an essentially different definition of science emerges. As for my own personal vita, I can draw on experience in academic physics and interdisciplinary activities concerning worldviews and cognition. Like most people, I feel that there is a gap between personal images of science and its *prima facie* image.

The above argument on the relation between personal profile and science is a matter of perspective, leaving to debate whether science is multiple or monolithic by nature. I for one think that there is not such a thing as "one" science, and that science is multiple at the core. The reason for this is not so much that it unites various disciplines, nor that the public image offers an indefinite number of multiplications of its identity, but rather that the perception of the basic scientific elements is unavoidably subjective, whatever the expertise of the beholder in sharing objectivity and discarding the redundant from the relevant. There is more to the deep multiplicity of science than mere social perspective: it reflects the subjective integration of the basic elements of science necessary for scientific research and discovery. Bruno Latour emphasises the "construction of fact" and its strategic propagation outside the strict workspace of science.[2] Rather than the concomitant pluralism of science, I am concerned with multiplicity as an intrinsic property of science.

What are my grounds for perceiving multiplicity of science at an even deeper level? Like most people of my generation, I was raised in a science-optimistic environment. The dazzling science-enabled achievements were abundant (the first moonwalk, heart transplantation, ICs, "atomic" — now "nuclear" — energy plants, transatlantic optical fibres, to name but a few), while its blunders ("ABC"-pollution, the A-bomb,...) were swept under the carpet of human error. Only at a later stage did I discover the need for challenging the concepts of the "Newtonian-like" reality that in practice surrounded this technological innovation. The lever at work in my case was threefold and technical: quantum mechanical superposition; the Lorentz transformations; and, somewhat later, self-organisation in dissipative systems. Their research called for a more profound approach to the subjects of science than their popular representations in the public media allowed. The media are guilty of the "toolification" of science, and of selling science to the public.[3,4] Alas, high-tech machinery is the stuff many a young man's

science dreams are made of. Indeed, it offers a view of science as the way to gain control over ever more parts of nature.

Later, following my "initiation" into research, I was able to gain an understanding of the process at "the forefront of science". I thus found that experimental facts are absorbed into theory, but, with several models and (proto) theories competing with each other, the question is which one? *Vice versa*, the competing theories and interpretations are in search of "their" facts. Since the predictions provided by competing theories should exactly match the window and precision of the experimental data, the mathematical difference between them should not be large. At the same time, there can definitely be a wide gap between concepts and laws. Theories are weighed one against the other, deconstructed and reassembled to build new ones. Depending on their own particular characteristics, they may lead to successful developments or disappear into a void to lead a latent life. Rather than consisting of a single body, science is characterised by a deep multiplicity at its core, which is a necessity for its future evolution.

Moreover, schools of thought and interpretation fight a courteous battle over dominion, which is where the sociologist of science comes in. Much like history, science is written by the victorious, but the criteria for victory in science should be more rationally defined and less power related.

The common ground of the various sciences largely coincides with the archetypal public perception: an attempted objective formalism for understanding, describing and predicting events and processes. In recent times, this "pure" image of science has definitely faded. One of the causes for this has certainly been its submission to utility, with science becoming market and policy-driven. There are also internal, more subtle causes, such as mediatisation for survival, grants policy, journal biasing and school-loyalty. Feelings of subjectivity, censure and aversion of science emerge, as its claims drift into shooting range of the public sphere.

My argument for "inclusive" science balances both perspectives:

- The outside perspective on science emphasises regularity, law and unequivocal explanation and meaning. It demands technological developments, and stimulates the achievement of tools. Concrete models in "Newtonian" terms are needed here.
- The inside perspective of science includes ongoing research, inquiry and questioning, alternative interpretations and speculation. This permanently unfinished state of science is not unequivocal and is prerequisite to development.

Although the viability of science leaves little choice, a balance between these two perspectives is needed, as is a degree of flexibility. Science is not either technology or basic science, but rather the two of them together entwined with society. It tends to be thrown off balance under economic pressure: the "old" premise of speculation in basic science is overruled when concrete achievements are demanded.[1] Generally speaking, there is a clear shift in the appreciation and assessment of science. Its applications and usage as a tool seem to confer more meaning and sense to the world view than the fundamental knowledge of basic science. This shift is brought about not only by the economic benefits of novel technological developments, but also by the discrepancy between public expectations of a monolithic science versus the underlying multiplicity of science. Many people see science as failing its purposes for not living up to the expectations of veracity and unequivocalness, whereas evidence of the value of technology can be found everywhere.

2. Stances in the Practice of Science

It is not my aim to give a precise definition of science to underpin my claims, but instead — bearing in mind the multiplicity — I will set about by sketching aspects of science. I have already argued that we should not refer to science as a whole but rather specify the area concerned. Terms such as basic or applied sciences, human sciences, medical sciences, and science for governing, are more precise and offer an appropriate perspective.

My aim is to clarify stances or fundamental rationales of science. The inside versus outside perspective opposition should not be taken too strictly. While many people outside the area of science have a thorough understanding of "real" process of science, including the vague aspects of scientific research, many scientists foster the monolithic concept of science, including its disputable claims to universality and final, irrefutable laws and explanations.

Let us first distinguish between the various types of scientific activity: i) applied research for new developments; ii) free experimental research; iii) theory supporting research, *i.e.* problem solving within a theory; iv) theory establishing, *i.e.* transforming or replacing the fundamental principles of the theory in relation to experimental evidence but also in order to cohere to insights, intuitions and interpretations.

The activities of all fields — exact sciences and human sciences, and industrial R&D and governmental science for policy — fall into one of

these categories. These activities can be subdivided according to several basic stances. With a Damoclean sword continuously hovering over basic research, I will first discuss the stance of the "victorious" applied sciences, the field reigned by "Promethean arrogance".

- Applicability of science
  Applied science makes a most impressive appearance, acting as it does on the world and riding on knowledge of the most fundamental principles at work in nature. It strikes us as a modern version of "magic", allowing to gain control over Nature's "*tenebrae*". From industrialisation, over electrification to technologisation and informatisation, it has moved in a continuous upward spiral of increasingly sophisticated technological developments (available to fewer and fewer people). This is the stance characteristic of the builder–inventor. The social tendency to foster this "polytechnical spirit" of "toolification", exposed in Ref. 3, is proportional to the economic benefits and improved utility yielded by technological innovation.
- Reflection on science
  I have referred to the — by now dented — image of the scientist as "tamer of Nature" and magician, in his role of precursor at the "frontier of science". From the expectations of new discoveries in the area of monolithic science grew a demand for progress, translated into social applications — the outside perspective. The positive perception of science has thus shifted from knowledge towards tool. The inside reflection will usually follow philosophically inspired themes such as "discovering nature's order" and "unification", or principles such as "objectivity", "uniqueness" and "fundamentality" or simply "heuristics" and "constructionism".
- Veracity of science
  The outsider — and the occasional insider — will rate science as "true" depending on the usefulness of tools: they either work or they do not. The veracity is measured by the effectiveness of the tool.
  The insider will evaluate the theory or model underlying his subject, and check the theory against experimental evidence but also against the principles of the theory, and its rationality, coherence, and understanding, interpretation and intuitiveness.[5] The development of theories — the evolution of science itself — gives rise to a range of issues including interpretation and inner contradiction.

This, from theoretical — and later experimental — fact, *e.g.* in QM and RT, opens the gates to "unconventional" scientific concepts. The "Newtonian translation" of this is less straightforward and the monolithic image is shattered. The new concepts are often referenceless in the daily environment and easily lead to doubt. Somehow, the "old" premise of speculation is regained, albeit negatively. Far from being veracious, science now seems prone to ambiguity.

- Creativity in science
  Science itself is an ongoing process of creation. The positivist metaphor of "the ship being continuously rebuilt while at sea" appropriately represents the ongoing reconstruction of theoretical formalism put to practice, and *vice versa*. This view is often contrasted with the metaphor of "a living tree with some branches and twigs that bud and flower while others appear weakened or dead, and whose stem represents simple universal principles", a view that is not sufficient either. The creativity of the scientific process is better expressed through its multiplicity: "a fleet of ships continuously rebuilt while at war on a stormy sea".
  Creativity in science — much debated already, cf. Feyerabend — is without rules, contrary to science itself. However, since the creative subjects of reflection are intended to become science, the intermediate "virtual walks of the mind" do not matter in the end, even though in the process of creation they are the exciting and playful vision in the dark; they are the idiosyncratic views that are continuously being compared, tuned and differentiated according to explicit interpretations of theory in academias and literature. From the side of creativity the deep multiplicity of science emerges as a necessity for its evolution.

The various stances have different aims and consider different situations. While not incompatible, they tend to lead to difficult communication between adherents of the different stances. In practice, a mature conception of science will need to include the views of all stances mentioned. I will discuss some of the bridges and gaps in the integrated social process of science.

Currently, the "applicability of science" is a measurable entity valued at billions worth of money.[6] This has led to a policy of investment and priorities in science. Specific domains in science with outspoken economic interest

are stimulated (with exemplary programs and institutes in Belgium): information technology (TELENET,[7] IWT), semiconductors (IMEC), biotechnology (VIB), new materials, energy sources (VITO). Policy makers cannot remain passive in the face of global economic competition; "national champions" of industrial technology are protected and fostered leading to a situation akin to where a state becomes "State Inc.".[3] The industrial development feeds on scientific innovation, which in turn builds up the state's economic power. Its importance to industrial and concomitant economic development has changed the view on science, and a "new" responsibility and morality of science towards society has emerged.[8] The government resources for science — scarce by definition — were and are redirected from the basic sciences to the applied sciences.

Except for DoD resources (Department of Defense), the current situation in governmental science policy in Belgium,[9] reflects the same tendencies as in the US.[6] Private resources *per capita* are beyond comparison. The model of technical development for economic growth is applied and aspired globally. What exactly is the implied strategy and how does it affect the process of science? Initially, the model was addressed in *Science – The Endless Frontier* by Vannevar Bush (post-WWII Director of the Office of Scientific Research and Development, USA).[10] This report puts forward the achievements of science in WWII and its impact on the future of defence. Here, the process of science is claimed to lead from basic research over applied research to technological achievement.

In the course of a few decades, the linear model was generally adopted or recognised and led to investment policies for basic sciences according to scientific disciplines, with success. Later, for reasons of economic growth and competitivity in the global situation, the model and the concomitant resources were adjusted. The modifications included strategic choices by government institutions between fields and areas of research, feedback through the demands made by users (*e.g.* the medical world) and consumers, and policy makers with demands for technological competitivity on the global market.

Definitely, society reflects on science in terms of high-tech tools. The POPA (Panel on Public Affairs of the American Physical Society), in a report to "mobilise" physicists against the decline of the basic sciences in the eyes of policy makers, states:[6]

> "Most analysts agree that scientific discoveries based on research are necessary but almost never sufficient foundations for new tech-

> nologies and economic growth. While many new products and processes have some origins in scientific discoveries, the scientific discovery is often far from the most 'important' or 'difficult' of the steps leading out of the lab and into the world. It is almost never a sufficient step for the civilian marketplace. The 'I didn't actually build it, but it was based on my idea' rationale now invites scorn rather than respect."

The question then arises whether the "basic sciences" are in need of revalorisation. Basic science itself has continuously evolved (even more so today, for some benefits are trickling down from the applied sciences). Fascinating subjects have been discovered and developed: time-warps; quantum teletransportation; chaos and complexity; non-locality; quantum computation; Bose condensates; *etc.* (notice the physicists bias). While (as yet) not translated to tools, such findings contribute intangible elements to contemporary culture. In the sphere of basic science, such concepts — anti-intuitive but theoretically sound findings — are close to the process of creativity, and in culture, they require inclusion, *i.e.* they change the "mental tissue" of daily practical truths and past scientific knowledge. So science does offer a conceptual challenge beyond the "Newtonian translations" of tools. Reflections on these concepts are possible pathways to regain the essence of science: the deep inquiring into and questioning of matters that were previously unknown and are therefore related to the mysterious. Their inclusion in our world views helps to retrieve the essence of science.

3. Tentative Pathways to Inclusion

In the above discussion I have looked at various stances in science, and at how economic and social factors tend to foster the image of applicability of science and at how it results in narrowing down the essence of science. While there are many reasons to support inclusion, I will give some sketchy arguments why it is legitimate to advocate inclusion in our worldview, based on findings in physics. Emphasising the unquestionable value of Newtonian mechanics in its window of applicability, I will briefly mention the chimera of the "Newtonian" world view. In a nutshell, it would mean that "ruled by Newtonian mechanics, the universe would evolve in a space–time theatre constituted of material elements obeying Laplace's universal predictability and interacting according mechanical laws to conspire up all the parts of our world".[11] It is the hallmark of the die-hard materialist reduction of the universe (of which Isaac Newton was not an advocate at all), which science

seems to have inherited.[12] While modern science (GR, QFT, Strings, ...) is not formulated in similar terms, reductionist variants still flourish. I will therefore choose some elements of inclusion from science which alleviate or counter the reduced vision of the universe.

A quantum implication; while our daily experiences tell us to expect objects to have a single location or one property at a given moment, in quantum mechanics — among many other anti-intuitive properties — we can find systems without a non-actual spatial location. That is, their spatial locality is not restricted to one spot, but only so after it has been measured. Not that it is diffuse in some classical wave fashion; in the time it takes to carry out the measurement, its actual outcome may have cast the system in a spot well beyond the reach of light. For that matter, non-locality can be seen as a special case of simultaneous non-compatible properties,[a] *e.g.* opposite spin directions or opposite momentum directions. This quality is expressed even more intricately in composed quantum systems, where it can lead to entangled state functions.[b] Entangled systems have the property of influencing each other — possibly outside the light cone — in a causal but non-deterministic manner. That is, while a measurement conducted on one of the entangled components has some possible known effects on its joined component, it cannot be predicted which of these will happen, and the effect will not be bounded by the velocity of light. To translate these matters directly into knowledge on cognitive processes (of type "World 2" and "World 3"), it will not suffice to make the necessary changes and follow a reductionist principle. To point out the implications of the effect for daily reality may strike us as a daunting task. Still, for a true appreciation, the percolation of "micro" processes in our most profound being of mentalness should remain considerable.[13] It does help to overcome the "fallacy of simple location", *i.e.* the metaphysical substrate understood as the abstracted bare entities exposing properties embedded in space and time, instead of

[a]The quantum description of systems contains state functions whose modulus squared is a probability measure. The non-locality can then be simply expressed by the superposition — weighed addition — of two or more wave components.

$$\begin{cases} \Psi = c_1\psi_1 + c_2\psi_2 \\ |c_1|^2 + |c_2|^2 = 1 \end{cases} \longrightarrow_{\text{measurement}} \begin{cases} \Psi = \psi_1 \\ P_1 = |c_1|^2 \end{cases} \quad \text{OR} \quad \begin{cases} \Psi = \psi_2 \\ P_2 = |c_2|^2 \end{cases}$$

[b]Entangled states of subsystems ψ and ϕ, the properties of both are inextricably related:

$$\Psi = c_1\psi_1 \otimes \phi_1 + c_2\psi_2 \otimes \phi_2 \qquad |c_1|^2 + |c_2|^2 = 1$$

substance as a substratum for all properties including space and time.[1,14]

A **relativistic implication**; among a spectrum of implications, relativity theory leads for instance to "plasticity" of space and time, there is a definite breaking away of the absolute space–time theatre. The personal trajectory relative to one another and into gravitational fields continuously transforms our spatial dimensions and clock timing,[c] not only ours, but all objects with integrating oscillators ("clocks"), *e.g.* computers. Although minute, the effects are omnipresent and essential on the atomic and cosmological scales. For instance, all observers, due to their inner relative movement, do not live in a sharp "time cut", but rather a continuously changing "time zone".

A **complexity implication**; is the process of "emergence", *i.e.* the emergence of new properties in systems of multiple interacting agents. Some physical many-particle systems expose, in a far from thermodynamic equilibrium situation and at the cost of continuous energy input, highly correlated behaviour. That property lies at the basis of the emergence of self-organising structured aggregates. The cause is essentially to be found in the non-linearity of the dynamics of the system. For example, the discretised map of the logistic equation for the evolution of the population in a limited environment offers the simplest appearance of "chaos" and complexity:[d] the properties of sensitivity to initial data, phase-space restrictions, and determinism. The mathematically formulated physical models proved to lend themselves for wide qualitative applicability in life and social sciences.[16–18] For example, living creatures — as structured and aggregates — need "food" (energy and matter) in order not to decay according to the second law of thermodynamics. The occurrence of self-organised modules with proper interaction modes represents a "*deus ex machina*" solution for the proliferation of non-physical "entities".[19] An exemplary and typical ap-

[c]Relative time lapse of clock '1' and clock '2' in relative motion over a closed circuit Γ with variable velocity v_{21} (angled brackets indicate mean value).

$$\Delta t_1 = \Delta t_2 \left\langle \left(1 - \left(\frac{v_{21}}{c}\right)^2\right)^{-1/2} \right\rangle_{\Gamma_{closed}}$$

[d]The logistic equation models the time evolution of a population N, given birth rates r, death rates M and niche resources K. When discretised and rescaled, it leads to the logistic map, exposing the essential properties of complexity.[15]

$$\frac{dN}{dt} = rN(K - N) - mN \qquad \longrightarrow \qquad x_{n+1} = \mu x_n (1 - x_n)$$

proach to this problem is *e.g.* the nature of consciousness in relation to, for instance, the complex dynamics of the neuronal network. This "neural correlate for consciousness", is considered a particular brain architecture co-realizing the emergent process of "consciousness".[18]

The reader should excuse me for choosing the items conservatively. I did not mention, for example, implications of biotechnology in relation to the identity of living beings, the parallel universes of the "Many-Worlds" interpretation, "Big Crunch" scenario's, quantum teletransportation, *etc.* I have preferred to choose items "canonised" by science, but not readily translated into our worldviews.

4. The "Forgotten" Grammar of Speculation in the Sciences

What is the place of process, higher-level organisation, functional aggregates or more common items such as language, signs and cultural artefacts in the contemporary ontology of science? In the previous section, I suggested, at my proper discretion, some entrances to inclusion in world views. I will now reflect speculatively on inclusion for an extension of ontology, *i.e.* the sphere of entities being existent. I will attempt to provide some supportive arguments for an inclusive realism, taking care not to move into unsubstantiated speculation.

A major — at times criticised — concern of science is to conceive of reality as a whole and to pursue unification, *i.e.* to construct a model as complete as possible in relation to our knowledge of our world. This means that science will always be intrinsically connected with a form of realism. Depending on the image of science, this reality can be explicitly knowable, restrictedly representational, merely functional and coherent, or completely unrelated to perception. It is only beyond empiricism that our world may regain a realist form.

Notwithstanding the economic pressure and industrial demand, there is a renewed scientific interest in the phenomena of life, cognition, world views and other intrinsically interdisciplinary topics. The ontology suggested in the context of these new developments is commonly too restricted. Following the scientific principle of the "economy of basic entities, principles and laws", there is a questionable consensus to attribute to the elements of the physical realm an ontological existence, if at all. As a result of this widespread, but restrictive, approach to science, the world that lies beyond the involvements of the followers of this creed is a no man's land. Higher-

level systems, based on complex compounds or intricately organised are readily deprived of their ontological reality in spite of their marked irreducibility and "closure". Instead, in most cases, the reality of such systems will be thought of as a "conventional", *i.e.* conceptual or cultural artefact. At most, such systems are recognised as "processes", although at the same time their reducible ontological status is pointed out, *i.e.* no additional quality or previously non-present property is recognised other than those of the components.

We have seen how in non-linear dynamics various aggregates or emergent modules emerge and make up an effective part of reality.[16–18] There are many processes which, in their dynamical form, are identical, regardless of variations in the material character of their elements, *i.e.* regardless of the nature of their substrates. The transposition and adaptation of non-linear dynamics and phenomena — beyond the metaphorical use — from one scientific discipline to another, leaves questions unanswered on the proper existence of the emergent entities.

In support of a speculative elaboration of inclusive ontology, realism should be redefined from a monolithic concept to an inclusive realism in a process of merging materialist realism, and the realism of biological, mental and social systems. Various tentative definitions of the concept of reality have been put forward; *e.g.* "something exists if it exerts a causal force", "what exists is independent of consciousness" or more generally "which exposes the disposition of influencing". The latter conception of reality definitely embraces a larger ontology, akin to an inclusive ontology.[19,20]

I will briefly illustrate this idea for "cognitive reality", which has been developed into a model of integrated emergent layers, *e.g.* references in Ref. 20. A "cognitive entity" — a module for mental activity — can be said to exist when it can be generally and cognitively influenced as a near-stable configuration, *e.g.* in reasoning and communicating about it, and when the number of different states it can be in is limited. The cognitive entity is endowed with properties and relations with the other elements of its layer. Their internal coherence relates to language as well as to concepts of experience, and may well constitute their basis for emergence. The extent to which it is related to pendants in the physical and other layers enhances its identity and its granted coincidence with a physically real entity. This variable correspondence relation is put forward between entities of the ontological cognitive layer and their pendants in physical or other layers. Clearly, such an inclusive ontology raises many questions *e.g.* concerning the transience and unequivocalness of ontological elements.[19,21]

Summarising, I have argued that scientific research cannot be reduced solely to an "unbiased" inquiry or objective methodology, since a speculative grammar is one of the intrinsic qualities of science, accounting for its underlying multiplicity. Speculation on inclusion in science is only possible when the deep multiplicity of science is allowed for. From the perspective of society, science "needs" to be reduced to the singular, and as such it fulfils the need for reassuring control, while, most poignantly, its utility for economic development is its translation to tools.

> "This fallacy consists in neglecting the degree of abstraction involved when an actual entity is considered so far as it exemplifies certain categories of thought."(A. N. Whitehead in Ref. 1)

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TO KNOW OR NOT TO KNOW, ONE WAY OR ANOTHER

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Since my early days, Science promised a universal method to explain everything, but university science with its inner contradictions left me bored. Ortega showed that science can fossilise and become superstition. The African tropical rainforest around 1963 and audacious new thinking together with young French scientists paved the way to my later analysis of living system hierarchies. The rainforest is a great debunker of arrogant scientists. Its plants and animals are countless, its inner subdivisions are not sharp, timing of events there is imprecise. In highly complex ecosystems no situation is recurrent. Hierarchical systems analysis, chaos theory and fuzzy logic, all of the 1960-ies, show the same way. Time is no factor, but an invisible dimension, a measuring stick, and visible space is 3D. Knowledge from foreign lands and from the past often sees reality as "more or less" defined, "elastic" ("jam karet", rubber time, in Indonesian). Our neat science predicts correctly how stars move, but not epidemics or jobless periods, or tree growth. The dilemma of structure (3D) versus becoming (4D) always was central to human thought. It is met by two axioms defining an elastic universe with fractal dimensions. First, structure is a very slow process and process is a very short-lived structure. Second, due to a short life-span, humans can only perceive infinity if broken down, folded, refolded *etc.*, a fractal image. These axioms and some rules derived yield a logically coherent image of the universe, inclusive of but broader than science as taught in schools today.

Keywords: rainforest, dimensions, factors, fractal, fuzzy, elastic universe, learning, traditional science

1. The Why of the How

For somebody who is used to letting objects of research speak for themselves, employing the third person in science writing goes completely without saying, so it is never said. *The marble rolls down an inclined surface with an acceleration determined by its mass,the force of gravity and the angle of the surface (as the marble itself told me in my experiment).* No scientific paper ever contains the part between brackets.

So, as an old hand at science, I have, as you will understand, trouble in starting to use the first person in singular. The closest I came to this in my earlier writings was the French custom of referring to "us": *we see that most Amerindian graffiti in the rocks in French Guyana are found in the rapids.* Who are *we*? Is this the *pluralis majestatis* of the arrogant scientist? In my mind, it refers to several authors, or rather to both the authors and the readers. Together, *we* see things.

Why is it that people get into the habit of writing and speaking in such a peculiar way?

2. The Why of the Who

To avoid using the first person singular is to hide an explanation under an objective surface. As soon as I start to use "I", two main options exist. The first is arrogant: "I think so, and you ought to think so too, because I tell you so, with proof." The second is biographical. It explains my thinking by describing my path in life leading to such thoughts. It is a letter to the reader, rather than a discourse. It is not polite, because one should not be talking too much about oneself in civilised society. Still, there is no other solution to explain the why of the who behind these thoughts.

As a boy, I would feel embarrassed when there were things I failed to understand, and even more embarrassed when my outside sources of understanding proved to be biased — books, teachers, even parents. The human world was full of errors, full of insight that went askew somehow. Shortly after the Second World War, when electrical batteries, hand lamps and metal wires were made available once more to people who were non-adult, non-German and non-military, I discovered for myself the wonders of electricity by playing. My toys became my teachers. What they told was true — indeed, if you do not believe me, go and *see for yourself.* Your electric bell will work just like mine.

The times were those of high hopes for science. It would invent solutions for all our troubles. There were reasons, then, for hope. Since the late XIX Century, feedback loops between industry, land use, medicine and science had been driving a spectacular decrease of hunger and poverty in the world. These material conditions liberated many people from the debilitating chains of bare survival. Otherwise, neither democracy nor investments in brains and ideas would have been possible at a global scale. The benefits of course blinded the generation of my parents, and mine when we were young, to wars, land exhaustion and humanitarian medicine-induced over-

population, all of which had become much grimmer and more dangerous. Indeed, they were brought about by the same science that had brought us and maintained the lifestyle we so cherished and endorsed. Now what was so special about science that made us fully trust it?

Science promised us knowledge of all that exists in the universe. Science itself calls the set of its ways and approaches a "universal method". Method, in ancient Greek, is composed by $\mu\epsilon\tau\alpha$ (meta = together with, towards) and $o\delta o\varsigma$ (hodos = road). In other words, it is the *road leading towards* the destination of science, *i.e. universal* knowledge. Hence, science is taught in *univers*ities. My Latin school, when I entered it, had existed 475 years since its foundation by monks, seeking to teach another universality. Attending classes on the Sciences side, I received a thorough training in mathematics as far as integral calculus is concerned, modern physics through quantum theory, chemistry, and biology up to cell chemistry. All this corresponded to what was taught at the university in my father's youth, as he told me with not a little pride in the advances made since then. Indeed, for centuries the universal method has led from data via hypothesis to proof — *quod erat demonstrandum*. A scientist must prove things before accepting their truth. Beware, young man, lest you neglect proof.

I would invite the reader to include in his readings of Arthur Conan Doyle's works not only Sherlock Holmes, but also such titles as "The Lost World". They provide a glimpse of the sheer brilliance of the scientific mind at its summit at the *fin de siècle*. By the way, Conan Doyle also wrote a "History of Spiritualism" in 1926. However, I first met with Sherlock and science.

The society I come from, and my father's family, were both imbibed with science. Society as a whole accepted science with little criticism. My mother's side descended from travellers, mainly to the Far East. I was born in a village, then green, on the border between forest plantations and meadows, where one could see the spire of Utrecht's gothic cathedral from 10 kilometres' distance. My school had been classical, including the dead languages. This mixed context partly explains my intuitive choice of a study in which life science met travel and a profession with a wide time horizon. In 1956 I started studying tropical silviculture, only a few years after it ceased to be called "colonial forestry". The detail is important. It shows that the times were approaching a vital turning point. The run to the revolution of 1968 had begun.

After a year at the university, I was bored. I considered service in the *Koninklijke Marine* (Dutch Royal Navy), for this would at least allow me

to travel and learn things new and exciting. It was a dead point in my life, but also the starting point for serious thinking.

3. Reconnaissance

During my first university year, I found that science as such cannot be taught. What I learned, often by rote, were known facts and conclusions and their scientific proof. In fact, this is one result of science, perhaps best called mere information. In spite of all this information, coherence was often lacking. The symbol of my growing doubts was my desk, according to physics an organised cloud of invisible particles. This perhaps was the mystery of my desk, but still the two images never succeeded to blend in my brain. A student is wont to consider this as proof of his own stupidity.

So in order to become wiser, I began to read all subjects, ripe and green, including occult texts. Three essentials emerged. First, why not go to a commercial clairvoyant? Why not, if I was so uncertain? — one severe adviser asked me. Second, forecasts of events were less important than the explanation of my own potential. Third, place, time and rhythm were of the essence. Three o'clock is tea-time. In only one season, from one particular soil, one can reap the unique grapes that yield one special wine.

From that point on, I organised my own studies, without neglecting my university career. An excellent thing about Dutch universities in those days was their complete academic freedom. Course attendance was not compulsory. Students could take their examinations at the time that suited them best and take as many years as they deemed necessary to graduate. I did not realise at that time, that this was part of an all-high in freedom and excellence in European scientific research, roughly between 1945 and 1975.

Next to my silvicultural studies I absorbed Dutch translations of the Spanish philosopher José Ortega y Gasset, fashionable after he died in 1955. Later, the desire to read the original was a strong motive for me to learn Spanish. Ortega taught me much. Indeed, I still am in discussion with him. "Clarity of language is the politeness of the philosopher to his readers" is one of his precepts. It still keeps me wary of obscure, ambiguous texts claiming to explain all. The "vital reason" that Ortega substituted for Kant's "pure reason" was to inspire me during my whole life. Indeed, I could not conceive of any other kind of reason than the one linked to a person's project in life. Indeed, "a human being *is* a project". Third, he showed that any new idea *is born* in the mind of one person. The idea

becomes *fixed* when written down. From this "written seed", it *grows* in the minds of others. At first, people understand it well enough to dismantle it and to build other versions. Then come the disciples. They understand the idea, but not well enough to modify it. They *believe* in it as an axiom. The idea ends up with those who use it as an incomprehensible ritual, a *superstition.*

In parallel to the assimilation of Ortega's arguments, I checked whether astrology worked or not and, whatever the outcome, why? I found contemporary astrology to be today's superstition, the *fossil* of an idea on the organisation of the cosmos that once was alive, millennia ago. Ortega's rule, then, applied to astrology. Four thousand years ago, the *corpus* of astrological knowledge was vital enough to inform the building of Ur of the Chaldeans. Today it is used most often as a tranquilliser, prescribed by believers. Fossil knowledge was an intriguing discovery. Through my readings I found other cases, such as magic, being a fossil set of techniques, or the digital yin–yang concept reviving today in the binary language of computers. This period of six years prepared my later decision to avoid the founding of a scientific school with disciples. I would teach students how to develop their own inborn genius.

4. The Great Forest

Like most young students approaching graduation, I believed I saw the world with sharp contours and knew where I was going. However, doubts about the universal claims of science had kept nagging. In the beginning of the "sixties" we went by boat, honeymooning, to the Republic of Ivory Coast, and there the great rain forest destroyed all my remaining belief in the omniscience of science. Even scientific claims to some sort of *potential* to know everything became totally unacceptable to me. Indeed, the argument of "knowing the rules is knowing the game" did not convince me any more. Intuitively, I grasped in the forest the "determinate chaos" that in that same period was being discovered elsewhere in the world by chemists, physicists and meteorologists.

Those were the days of Jacques Bergier's *Matin des Magiciens*, followed by a decade of audacious doubting and audacious new thinking. I had the extraordinary chance to be included in a group of young French scientists boiling with creativity. Now, over 35 years later, I am still working with several of them. In West Africa, one of these friends, F. Hallé, discovered the texts of the English tropical botanist Corner and his *Durian theory,*

or the origin of the modern tree, including the "geometry" of trees. The subject never left us again and we wrote books about it together. To me it gave several keys to a better understanding of both the natural reality as we observe it, and its mirrored image in the mind we call science.

The great rain forests in the tropics, where I lived and worked for fourteen years and have travelled extensively since, are great debunkers of arrogant scientists. It never will be possible to describe all species of plants and animals that live there. It never will be possible to divide the forest into parcels with sharp, natural boundaries. It never will be possible to measure the time of forest events precisely. Most important of all, in this most complex of all terrestrial ecosystems no situation ever repeats itself exactly.

Gone are our comfortable categories in space and time, our representative samples, our average conditions, our sharp limits and sharp moments. Einstein, as quoted by Capra, said of mathematics: "As far as the laws of mathematics refer to reality, they are not certain; and as far as they are certain they do not refer to reality." The same applies to measurements. Their mathematical precision most often refers to an instant picture of a forest object that is neither precisely the same the next instant, nor precisely the same as whichever of the neighbouring forest objects.

5. Travelling in Space and Time

The following paragraphs are based on my studies as I have set them out above. I will discuss my woolgatherings comparing them with the way in which faraway people see matters. I will talk of people far away in space, living in the steaming tropical jungles, to say it with the words of the Romantics. I will refer to people far away in time, from past civilisations that we know from the remains of their writings, graphics and buildings.

In the current maelstrom of scientific publications, basic notions are often used carelessly. Dr. Rolfe Leary, whom I helped found the IUFRO subject group on philosophy and methodology in forest research, reviewed about 80 articles in a well-known refereed research journal in our field. He found some 70 of them lacking a paragraph on methods and definitions of their concepts. Most referees discouraged such paragraphs as a waste of money and effort. Few are the universities where students learn the strict definitions of the meaning of the basic terms of science as we practice it. To illustrate this, you need but count the number of times that you come across expressions such as "time factor", "the influence of time" or "caused

by time" in scientific publications.

Well, time is no factor, because literally "factor" means "maker", and no proof has ever been obtained of the existence of "realistic time", a stream that makes things happen, as supposed by the ancient Greeks ($\pi\alpha\nu\tau\alpha\ \rho\epsilon\iota$, *everything flows*). Still, the idea is widely spread, as proven by the beadle who wrote to the church council: "Crows often sit on the hands of our tower-clock, so obstructing time in its progression."

Time since Einstein is seen as "relational time", a measuring rod on which seconds, minutes or hours are points of reference. The minimum number of such measuring rods or co-ordinates, which we need to represent reality as a portrait which you and I both can recognise, is four. They are time, length, width and depth. This is the "Minkowskian 4-dimensional space", with the great advantages of simplicity, rigour, soberness, and an all but universal application. Time here is the dimension beyond imagination. We "see" 3D space directly, but it is not constant. With every touch of a key, the image on the screen is different. With every turn of my head, the perceived image of my room is different. Now I see the bookcase, now I don't. Time seems a trick of the mind needed to bring order to our observations, without knowing for sure whether or not time "exists". Because direct perception of time is not feasible, we have built instruments that make the reference visible, *e.g.* hourglasses or clocks.

Time perception by virtue of little machines called clocks, which imitate the course of the sun, the moon, or electrons, is an amazing quirk of European civilisation. Were you ever lying in your hammock in the great forest, with a touch of fever, between sleeping and waking? Then dimensions can dissolve. You may become uncertain whether you are the forest or the forest is you. Such timeless experiences were expressed by Xuan-tzeu millennia ago in China; was he a man dreaming he was a butterfly, or a butterfly dreaming he was a man?

Our simple European frame of reference is a time line, divided by the present into two zones, the past and the future. Most of our "contemporaries" on this planet by no means share this view. A researcher who had lived a long time amongst rain forest dwellers in Colombia once told me that these people referred to "long time" and "short time" — not the middle term so dear to our managers. The long time is proper to Creation, the forest in particular. Humans may not meddle with the long term. Such changes are bad, as known by accounts of past events, stored in collective memory. The short term determines the daily rhythms of sleep, food, drink, copulation or shelter. In order not to spoil the long time, the acts in short

time must follow clear rules. Such cultures we call "traditional", a quality considered a vice in our "progressive" society, a virtue in theirs.

During my ten years in South American rain forests, no research with sophisticated tools was possible. Small computers were unborn. So was refined automatic gear to register microclimates. Advanced biochemical analysis and precise identification of plant species could not be done locally, although I improved the latter a bit by founding a herbarium collection.

My possibilities were therefore restricted to the old method of drawing a portrait, a "model to scale" of my object, with barely more tools than a compass, some double decametre tapes, a machete, coloured pencils and notebooks with centimetre grids. I introduced time into these forest drawings by analysing each tree according to architectural criteria: fully grown trees, potential trees or decaying trees. In the drawing, each tree class was given a graphical code. This allowed assessing past and future development, *e.g.* potential trees would grow on, and fully grown trees would decay over time. The same was done for a tree and its branches, or a branch and its leaves. The resulting figure presented the complexity of such forest diagrams shown by a page from my field-book.

6. An Elastic Universe?

There is a typical Indonesian expression saying "jam karet", *i.e.* rubber time. It is used sometimes as an excuse, sometimes as a joke. However, it points to a profound meaning shared by many tropical peoples. If time is elastic, events cannot, or barely, be forecast. Now the same was true of my spatial architecture of branches, trees or forests. There is a pattern, but it is elastic, a hazy image around a clear outline. The haziness is caused by the inequality in size, growth rate, and/or life span of organic systems and by the unpredictability of impacts from outside forces such as wind, fire, disease or inundation. Natural things and living beings are inherently fuzzy.

We can contrast this to the literal "punctuality" of our occidental images, calculations and machinery, including computers. If there is haziness, it is ascribed to random error. Things are *made* to be precise. The mental trick of our science is to say that the crisp outline of a phenomenon is its true nature, so we superpose metres and hectares and real numbers upon the objects we observe and interpret. The great forests and their inhabitants taught me otherwise. It is the hazy outline and the imperfectly predictable sequence of events that truly reflect the essence of natural phe-

nomena. It is not the crisp image that faithfully reflects the world we live in; if we pretend it does, we are in error.

Although tropical rain forests show this very clearly, it did not show up only there. Since the 'twenties, with Heisenberg's Uncertainty Relations, through the 'sixties, with Lorenz's fuzzy meteorology, Prigogine's bifurcation diagrams,[1] Zadeh's fuzzy logic[2] and Mandelbrot's fractals, the theory of determinate chaos has taken shape. This subject is extensively dealt with in numerous books. Here, I would emphasise that, according to known rules defining order, objects can be built that cannot be distinguished from chaotic objects. No study of such objects can reveal their building rules. In the words of Prigogine, history has to be reinserted into science. It is necessary to know the initial conditions to understand the process and the result.

The fuzziness of contours in space and time raises another problem. Objects with a fuzzy outline are easily confounded with other objects. Indeed, social scientists told me that many forest dwellers do not understand our crisp drawings or photographs, in which they do not recognise the represented objects or beings. The fuzziness of the latter casts doubts upon their identification. Their *similarity* may be stated with full certainty, but proof of the full *identity* of two objects is inherently impossible. Now in all societies, identification of animals, plants, agricultural fields and other daily features was successfully achieved by separating the icy from the hot, the edible from the poisonous, my property from yours. This success is due to the use of scale. A map using a kilometric grid will show other limits than a map that uses a millimetric grid. Fine limits require fine grids. Small systems plus their interactions build larger systems in a hierarchy from the atom to the sun and beyond.

The advance of mainstream science has indeed contributed to a more inclusive science. A new door has opened to viewing objects no longer in terms of highly precise and sure descriptions and identifications, with systems analysis (scaling) remedying this to a certain extent. However, precise forecasts of events in time and space often are inherently impossible, with some noteworthy exceptions, particularly in physics, *e.g.* the precisely calculated moments of all full moons in the year 4301 of whatever era.

For thousands of years, our culture has grappled with the dilemma of being and becoming. My image of "visible" 3D space versus "inferred" 4D change is only one of its expressions. Is there some crisp, primeval model behind the forest I drew, and is the uncertainty due to mere untidiness of "Nature"? Or is "Nature" a permanent jumble and is the sharp, cyclic

model behind it a mere figment of the imagination? I am asking this question with the great forests before my mind's eye, not the sub-microscopic world of Prigogine, which is the chemist's context. Rain forests are, together with the human brain and the great coral reefs, the most complex among directly visible systems on earth.

To a certain extent, the paradigm of a permanent jumble, or at least a jumble the causes of which are untraceable, is confirmed by the life-preserving success of the application of *more than one*, quite different "underlying models". Our road crosses that of Ortega again, whose "vital reason" is human reason determined by human life. Our agronomists distinguish grids (kilometric, hectometric, decametric), weights (kilograms, tonnes), or numbers (populations of plants or animals as production-carriers). My photograph of a rain forest taken from a helicopter shows that this morsel teeming with life displays no grid, no simple masses to weigh and no visible traces of countable populations. Such ecological "properties" are superimposed and forests interpreted as if these patterns existed at hidden levels.

The artificial clarity of outline appears in basic aspects of our own civilisation. It was at a recital of Korean classical music in the Opera House of Quito (Ecuador) that all at once I could feel the beauty of oriental music. I abruptly and fully understood that the tones of our classical music, perhaps since Gregorian choirs or even David's harp, are compromises. The third, fourth, fifth, ... octaves and musical intervals *cannot* yield regular notes, because in most cases there is no common factor, and "the same" note would sound a bit different ac*cord*ing (literally, setting the cords or strings) to each interval. In the Far East, no such choice is made, and tones display a kind of wailing between their slightly different positions. In Europe a fixed compromise was chosen, *as if* fixed notes existed, and these virtual notes then were *made* to exist. Our classical music carries the wonderful splendour of discrete thinking and oriental classical music carries the wonderful splendour of an elastic universe.

Like members of Far Eastern cultures, rain forest dwellers see properties that are quite different from those we see. So do the Wau of the Ecuadorian *Oriente* in the Amazon basin, with whom I had the privilege to work for some weeks. They do not draw straight lines in the forest, but follow convenient, twisting trails along hillsides and turning around big trees. Their pattern of agricultural, *i.e.* life-preserving, *property* is not defined in terms of a field, with its grid-like connotations, but in terms of a plant that produces food or other useful commodities. Harm such a plant

even unintentionally — putting the owner's life at stake — and you suffer the Wauwrani death penalty. This paradigm exists in other tropical forest countries too, where land use is temporary or communal, *e.g.* in Indonesia or Mexico.

The Wau and other such peoples have a precise knowledge of forest organisms, so they can tell which provide food or poison, medicines or spices, firewood or fibres. They know their plants and animals on a different scale and on much finer levels than those used for establishing property rights. Forest dwellers have much in common with taxonomists. This is not amazing. Indeed, taxonomists descend from apothecaries who had to know their species thoroughly in order not to poison their patients. The criteria once more are not grids, masses and numbers, but natural lines and patterns as observed fuzzily in organs and organisms ("...leaves from 10 to 15 cm long...").

An elastic universe is not only inclusive of classical science but also wide open to accommodate such more recent offspring as fuzzy logic and chaos theory. Moreover, it includes the basic assumptions of such different societies as rain forest dwellers, long-dead Egyptians or Chinese, and others described elsewhere. In this universe, the crisp statement "outside temperature is $-4.3°C$" is allowed, fraternally, next to the fuzzy statement "there is a light frost outside". In other words, the axiom of an inherently elastic universe makes inclusive science possible because it overcomes the paradoxes of the classical dilemma of being versus becoming. The two new axioms set out below appear here for the first time in print.

7. Axioms and Rules in an Elastic Universe

The next paragraphs contain a few *axioms* and *rules*. *Axioms* are basic rules that cannot be proven but have to be accepted if one accepts the paradigm. *Rules* are the counterparts in the elastic universe of classical *laws* of nature in the crisp universe.

Axiom 1 — *Pure structure and pure process are the extreme states at both ends of the infinite time axis.*

This axiom solves the paradox of being (structure) versus becoming (process). Indeed, a pure structure is a process so slow as to cause no perceptible change until the end of time, formally an asymptotic final condition. A pure process is a structure so short-lived as to leave no trace at the beginning of time, formally an asymptotic initial condition.

This axiom rests upon extremes, *i.e.* a state without any determinate

time dimension ($t = \infty$ or $t = 0$) versus another state without determinate spatial dimensions ($l \times w \times d = \infty$ or $l \times w \times d = 0$).

This axiom postulates linear time, not cyclic time, for several reasons. Perfect cycles do not exist, as biological and ecological research have established without any doubt. The usual analogy today is between life "cycles" or evolutionary "cycles" and *spirals*, nearing their points of origin but never reaching them again. Another analogy sees them as paths with a certain width, a concept that fits in with the elastic view of the universe. Indeed, a wide pathway is a fuzzy or elastic trajectory, including similar but not identical cycles in conditions prevailing within a certain interval of environmental stability. Beyond this interval, according to chaos theory, processes derail and a totally new order may arise.

Cyclic time is one particular case among many in the elastic universe. Indeed, a circle with an infinite radius has a circumference which is *both* a straight and a curved line, or neither. The contradiction ceases to exist, for the first axiom does *not* replace one paradox by another by substituting one image of the time dimension by another.

Axiom 2 — *Reality as perceived by human senses is a state with fractal dimensions.*

What are fractal dimensions? The key lies in a well-known statement from fractal geometry, saying that the total length of the British coastline depends on the length of the measuring stick used. If my ruler is one kilometre long, measuring will miss small coves and bends in the beach. With a ruler of one metre, these features are taken into account, but the measures will exclude sizeable rocks. A ruler of a tenth of a millimetre draws the coastline around every grain of sand. The coastline indeed becomes the longer, the shorter the measuring stick I use! A tiny stick, *e.g.* one Ångström ($= 10^{-10}$ m) long, would take the length of the coastline to such huge values as would allow us to start to *imagine* infinity as something quite beyond our daily life and yet as part of the physical world.

There is a link with dimensions, which I abbreviate as D. Imagine the *reality* of a measuring "stick" of 1 Å long. This mathematical "line", *dimension 1D*, can only be observed through a microscope as a tiny "point", mathematical *dimension 0D*! In fractal geometry, it is seen as having a dimension a bit larger than 0D, but much smaller than 1D. Such a number is a *fraction*, for instance 0.003D, hence the "real" dimension of the tiny measuring stick is a *fractal* dimension. A "point of impact" has a fractal dimension, *i.e.* 0.xxD. In the same way, a fractal dimension in between a line (1D) and a surface (2D) applies to a line with a tiny width. An

example is a "pine needle width" with a fractal dimension of 1.yyD. The "real" fractal dimension lies in between a surface (2D) and a volume (3D) in a "fat plant leaf" (2.zzD).

The axiom of reality perceived as a state with fractal dimensions also refers to evolutionary and physiological time. Indeed, a "mathematical point in time" (0D) cannot explain the tiny interval (1.0x D) needed for adaptation or reaction along the historical time dimension (1D). The manipulation of musical tones *because of* human perception exemplifies this. Another example is our clock, embodying a fine but uneasy compromise between the duration of the orbits of our planet around its axis and around the sun, the moon's orbit, and polar precession.

The following few rules, among many possible ones, will exemplify how the axioms define a version of inclusive science.

Rule 1 — *Classical sciences each cover a special area within the elastic universe and so do living and fossil knowledge systems with other paradigms, e.g.* magic, Taoism, astrology, alchemy, forest lore or numerology, to mention a few. The selection of a certain field by human societies, for each of such systems, obeys the commands of vital reason. It originates from a collective project under certain initial conditions, at a certain date in the history of a human society. Every such project feeds upon its initial success, then grows big and finally decays into superstition.

Rule 2 — *Perceived para-reality is a state out of the bounds of the five senses and of existing instruments made by the rules of modern physics.* This rule combines the first axiom, referring to an infinite universe, with the fact that researchers are mortal, and their instruments bear witness to this fact because they do not refer to infinity. Hence, research along the time axis is bodily feasible over a short human life span only. The elastic universe covers reality, para-reality, and a fuzzy transition zone in between.

Rule 3 — *Para-real phenomena must not be analysed as if they were "classical" scientific observations.* Their description must not use the terms for 4D experiences shorter than or equal to a human lifetime. Classical science is right to tell us, for instance, that reincarnation does not exist, although I doubt if it says so for the same reasons as mine. Indeed, "re" in reincarnation, "re" meaning "again", reduces the time dimension to a fragment covering a human life span or less. This is an error of scale. Consequently, the word "reincarnation" itself is misleading, so research based on this mistaken concept is bound to fail. Such research should be based on an awareness of the three concepts of infinity, zero and the elastic dimension of time, as reflected in our consciousness. This may take a form

similar to a package of complex memories vividly covering a human life span or a part of it (see also rule 4).

Other notions wrongly applied engender inappropriate research too, as we saw with concepts such as "time", "factor" or "dimension". This explains, for instance, why Dunne's famous "experiment with time" fell just short of a satisfactory explanation of the precognitive dreams he experienced to his dismay.[3] His "serial universe" still owes so much to the classical notion of time, that a superfluous 5^{th} dimension is introduced. It took me close to forty years to see this. I learned from this exercise. Hence, recently it took me six years only to see that, for similar reasons, Sheldrake's morphic fields are redundant.[4]

Rule 4 — *In the physical world, the fractal architecture of organic systems is a bridge between the "real", limited life span and size, and "para-real", infinite dimensions.* The earlier example of the sensation of timelessness perceived by a feverish person in the rain forest certainly rests upon the fractal organisation of such a forest, explained above by a "portrait or model to scale". Always described as *la grande forêt*, it shows to our senses a glimpse of the links between perceived scales, reality and infinity. Such glimpses are revelations. This is a notion from theology, linking God (the unknowable) through Creation (complexity as folded infinity) to the image in our consciousness of daily Reality (nature). In scientific terms, we proceed stepwise from nuclear physics to astronomy, level by level, intuitively glimpsing at theology in the process, a kind of parallel path of increasing awareness.

Rule 5 — *It is in human memory that the elastic universe, with its infinite dimensions, deposits its sediments.* The above examples, "reincarnation" and "precognition", show memory to be an apparent hotchpotch of things we "normally" know and things of mysterious origin we "cannot or should not" know. Their ordering proved to be impossible with classical scientific notions of proof and experiments only. Therefore, branches of science such as psychology, social sciences and in particular parapsychology have long been outcasts from the strongholds of classical science, and in some cases they still are. The crux of the matter was the requirement that proof should be verifiable by repeating an experimental study. In matters of the psyche, of the mind and of human communities, neither innocent experiments nor strict repetitions can exist. We saw how this is inherent to all sciences in an elastic universe.

Rule 6 — *Learning is more important than either information or repetition.* Classical science, as a knowledge system, emphasised the importance

of repetition for being the backbone of accepted proof and experimental research. Indeed, it is the spine of formal logic, which is a body of strict rules of reasoning. The repetitive pattern rubbed off on teaching, schools and even universities. Knowledge based on experimental, descriptive and logical repetition was and is taught repetitively, implying but not saying that repetition is the only way to truth. The educational struggle in the North American Bible Belt between champions and adversaries of evolutionary biology as opposed to creationist biology exemplifies this. It would amount to little more than a comical spectacle of battling anachronistic dragons, if it did not illustrate so well the issue raised here. The creationists' principle is the *miracle*, which is unrepeatable by definition. The evolutionists' principle is *natural selection–cum–adaptation*, claimed to be repetitive experimentally.

Only recently I worked on a book, "Struggle of Life", in which my coauthors M. and L. Rossignol showed by a ten-year experiment how genetic transfer acts *both* as a repetitive process and as an innovative mechanism.[5] The battle between miracle and repetition makes no sense in an elastic universe. It was the learning process, which made me aware of the issue. Nobody taught me precisely this, but my mental activities combined the repeatable with newly acquired observations, items read and items remembered from other contexts. The new combination, a result of refolding the infinite complexity of nature as reflected by my mind, was one of the drivers of the development of the insight expressed here as "the elastic universe".

A balanced development of mental power, boosted by education, is the only means by which human beings can hope to establish vital harmony between themselves, and what they perceive and identify, both inside and outside, as different from themselves. Classical science is a powerful tool to learn an excellent and necessary part of this balance, but inclusive science is necessary for teaching *how* to learn.

8. Perspectives for Students

My long quest has led me to a point whence I can now see farther than when I started. Can I see far enough? I will attempt to evaluate very cautiously the chances of inclusive science to become accepted by the human inhabitants of the strange and wonderful world in which we live. To understand the above phrase fully, I would have to define the "human". Only this word gives meaning to all the other terms: evaluate, cautious, accept, world, strange, or wonderful. However, I will not fall into this age-old trap

of defining humanity. Once more, I would refer the reader to Ortega. His statement that *each human being is a project* is enough for our present purpose.

When after 20 years I returned to the Republic of Ivory Coast, in the mid-eighties, the great forests had retreated over 600 kilometres. The marvel of the natural fractals, folding infinity into our finite world, had disappeared under chainsaw, fire, bulldozer and human multitudes. The huge amounts of unfettered energy also produced new, artificial but finite folds of concrete and steel. Exemplifying these, Utrecht's skyscrapers today mask the spire of its gothic cathedral that I could see from afar in my younger days. The transient nature of Nature is therefore vividly present in my memory now. To know and understand it better, I should have paid still better attention to what I saw, heard, smelled or felt around me and should have remembered it still better.

On the other hand, the number of pages I have read on science, philosophy, history and literature in general has now passed the limit where I can even try to count them. This makes one modest. Everything that I have struggled so hard to learn, as I told in the above pages, has already been discovered and described. I can now fully understand the Preacher (King James' Bible, Eccl. 1: 9). He wrote: "The thing that hath been, it is that which shall be; and that which is done, it is that which shall be done: and there is no new thing under the sun." So I would have to apologise for epigonism in my writings, if the social scientist Kahn had not provided me with a good excuse.[6] His title says it all: *"Tout change parce que rien ne change"*, everything changes *because* nothing changes.

You, young reader, you will have to start the same road all over again, the road which I followed before you. Still, in the elastic universe, and because of your duty to learn your lessons yourself, whether you want to or not, *the same road will be a bit different!* The results of my learning I captured in words more or less different from those of all other human authors, and so will you. Finally, you will understand the Preacher too. I recommend reading his whole book, highly relevant to inclusive science, for instance with its recommendation to live your life fully and enjoy it. Learning to think is not necessarily a dry and sad experience, but it can and should be an exciting activity involving your complete personality.

How can one say, let alone prove, that all human pathways are similar, when it is self-evident that the real landscape around us has so thoroughly changed in recent history? In barely half a century, *Justice*, a sacred and highly complex notion, was replaced in *practice* by human rights, an 18^{th}

Century *concept*, which in turn became yesterday's unbalanced bits and pieces of fragmented justice, which today is subjected to the game of negotiating individual rights, or rather interests. Likewise, cosmic *Love* degraded into fragmented "loves" as experienced by individuals, which today has largely become synonymous with promiscuous sex. Universal *Science* was split into mutually quite disjointed sciences, resulting in today's electronic highway — a gravel path composed of bits and pieces of unorganised information contained in virtual, not real, structures. Today's framework of reference for making sense of our lives is the hailed and sacred virtue of *Freedom*. However, it is already starting to decompose into loose and dangerous liberties.

In this respect, our planetary situation has changed enormously indeed during my lifetime alone. Between 1950 and the present, churches have ceased to wield major power, at least in the Netherlands. Psychiatrists are taking over the role of priests. Worldwide, the executive powers of states had no serious challengers as little as fifty years ago. Today, multinational enterprises and illegal organisations are serious competitors, and have seized power in some countries, leaving the state as an empty hulk. The latter three kinds of political and economical power have reached an uneasy balance that is always on the border of conflict. What they have in common is that they dislike free knowledge in general. They appreciate neither inclusive nor exclusive science. In a headline in its first number of the new millennium, the journal *American Scientist* asked the question: "How much free speech for scientists?"[7]

Today's passage of one artificial millennium to the next artificial millennium sits in the middle of this context, as I will demonstrate below. Industrial thinking is returning in strength, producing more *exclusive* science. With deforestation and ecological destruction, the *infinity* of natural dimensions has begun to disappear from our daily lives. The dimensions of agrarian or urban complexes, even big ones, are *finite*. Degraded justice is negotiation reduced to numbers, *i.e.* to money. Indeed, the old vice of prostitution is hidden at the nucleus of contemporary courts. Love has shrunk to pornography on the one hand, and to the artificial solidarity of social security on the other. The hidden nucleus here is the old vice of licentiousness, being the assumed right to gratify one's every lust. One traditional expression of universal love is purity in the acts of eating, drinking and procreation. They too are now reduced to numbers in the food, beverage and sex markets, based on numerical food science including genetic manipulation.

Lastly, the first centuries of experimenting with freedom, from the 18^{th} Century revolutions onward, have led to the schizoid and artificial distinction between supermen to the right and equal comrades to the left. There is no freedom in these notions, please be warned. The hidden nucleus of both is collective egotism. This also is the falsehood behind the *free market mechanism*, which expresses every value in numbers, *i.e.* in money needed to satisfy cravings immediately and repeatedly. I have witnessed the advent of most of the above shifts in thinking, and their results.

The name of materialism supposedly covers the above complex in the opinion of many critical minds. However, I think that this is merely anti-exclusive, as narrow-minded as exclusive science itself. Matter and energy are noble constituents of the elastic universe. Matter and energy do not deserve contempt only because certain arrogant people narrow down the scientific universe to them alone. Contempt is as dangerous as arrogantly overrating spiritualism, or adoring visions belonging to other peoples. Swooning before Rousseau's lingering "noble savage" is as misplaced as the adoration of Traditional (with capital) forms of knowledge, the fossilised legacy of brilliant minds.

The name of the new game of learning is conquering freedom of mind, which goes with respect for all others who honestly try to learn. The risk of the coming times is a wave of seductive ideological satisfactions for sale. You think *you* buy satisfaction, but really you let the product buy your independence from you. The worst temptation for young people who want to train their thinking is to have faith in the purity of universities. Many such institutions are bought by today's new slavers and paid by honours or research money. Still, students can find ways to train their mental faculties there, but on condition not to believe in the institution, but to seek the exceptional teachers. During my own studies, I found no more than two or three professors who contributed to my powers of thinking, the many others having left no notable trace on my mind.

Today, the situation is far worse. The industrial educational system is increasingly made up of compulsory courses and straightjacket-like theses. Curricula rest on repetition and insertion into or adaptation to some technical research programme or other that no student has conceived, but that serves those that want their projects staffed with people willing and well trained for special purposes. Such a system will lead you to a job as a brain slave.

This conclusion fits in with Alvin Toffler's "Powershift".[8] The book defines the shift in type of powerful chief dominating society in each of the

historical "waves", as the author calls them. Successively, these concern agrarian, industrial and information societies. Toffler sees the bosses as those who know how to use land, capital and, today, information. I define the people that in the three waves are bought and sold to do the hard work as serfs, wage slaves and *brain slaves*, respectively. Young, starry-eyed people once came down from the farms to the cities to do a glorious job in the newly born industry. As soon as many were available, wages went down. The new poor could decide their own fate no more and became industrial wage slaves. The same is happening today with the excessive number of people holding university certificates, for they are fast becoming low-cost brain slaves in the pay of information managers. University studies no longer concern scientific vocation, but "science policy" expresses them in sums of money. How to find an occasion to develop your *free and proper* thinking in this context?

Recent history has showed us the incredible force of the waves of the Internet, spreading through the societies of our planet. The Internet provides tools to end any exclusive way of thinking. However, these tools work only if the sheer shock wave of the info-flow itself does not reduce all information to gibberish. It is true that the Internet can boost inclusive science.[9] However, when abused, it may also easily lead to your life and thoughts being totally controlled by other powerful parties. The media regularly refer to demands for censorship of the Internet, so beware of the guard dogs! My conclusion is the equivalent of an appeal to all human and thinking beings, wherever in today's world. My own century is over. Still, there is a door leading to the next century. If properly opened, it will provide freedom of thought to those who really want it and are ready to invest themselves totally in going the way behind the door.

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A NATURALISTIC AND CRITICAL VIEW OF SOCIAL SCIENCES AND THE HUMANITIES

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Science can be inspired or not. It can be contextualised or not in the mind of the scientist. It can be culture-gender-context-sensitive or not. Our claim is that science should not be exclusive in the present-day world, or else it becomes a powerful instrument in the hands of the mighty, and hence against the interests of humankind. These very general epistemological points are admittedly ambitious, and may even sound ludicrous to the "established" scientist. Worse, they may sound that way to the philosopher of science, who should be the professional critic of the whole enterprise of science, rather than the would-be scientist. Our aim is to propose a few ideas in this tricky field inviting our fellow critics to be both firm and fair. We restrict ourselves to social sciences and the humanities, without touching on the question whether or not they differ intrinsically from other sciences. This type of criticism is needed in a time when the political context is not appreciative of the one civilisational precious product of the West, namely the critical and self-critical attitude which has brought us the delicate fruits of the arts, sciences and philosophy.

Keywords: culture sensitivity, context sensitivity, relativism, objectivism, civilization

1. The Epistemological Stands

Epistemology can be descriptive and it can be normative. We take it to be both. The normative aspects of our epistemological perspective will become

clear especially in the final part of this contribution. As regards descriptive epistemology, siding with empirical and evolutionary epistemologists,[1] we state that the sociology, history and psychology of science tell us a lot about the nature of scientific work, and hence about the status of scientific truths. We adopt the view that science is made by human beings and hence its results and insights ("truths", if that notion is indeed safeguarded) will be fallible. The way to underscore this statement is by situating science in a variety of ways:

- science is culture-laden, since it is produced in a particular cultural context;
- science is organised through and produces results in a political-historical-material context.

Let us elaborate on these two points: Science is culture-laden. Especially at the level of intuition or pre-scientific reasoning this is clear, although this view is far from being adopted as such by the average social scientist (*e.g.* the quantitative researcher in sociology or experimental psychology). This point is often discussed in terms of (cognitive) relativism. Among the different positions on the relativist side the one expressed in the so-called Needham question proves most interesting to us.[2]

This type of cognitive relativism is to be found in a small circle of theorists of science who study other great civilizations. (It is amazing that members of different circles in the area of research should know so little about each other — although there are exceptions, such as Restivo, Bloor, or Elzinga.) Scholars in this line of research try to determine whether and to what extent science may have cultural components.[3] In concrete words: is there a Chinese or an Islamic science, as some have claimed, and, if so, in what sense do they differ from Western science? An outstanding figure in this debate was Joseph Needham. In his monumental *Science and Civilization in China*,[4] he challenged the relativistic distinction between so-called Eastern and Western science. One could say that his basic tenet is that modern science is one and that it is universal. However, traditional science (*i.e.* medieval or "Chinese" or "Hindu" science) produced dependable knowledge on particular problems within a particular socioeconomic and cultural setting. It did so without achieving the level of universality characteristic of modern science, because it remained subordinate to the particular religious worldview or natural philosophy it grew in, according to Needham.[5] The interesting point for the present contribution is that some of his critics have suggested that the relativism which Needham dis-

cerns in traditional science, holds for modern science as well.[6] Elzinga and Jamison pick up this line of thought: any particular scientific tradition develops in a cultural context, which defines "the basic understanding of the man–nature relationship".[7] Thus the dominant harmony and equilibrium model of the prevailing Confucian class in China expressed itself in a philosophy of organicism. This in turn led to a use of science and a moderate development of scientific growth through innovation in China. In the 13th century, when science was seen as having served its purpose of satisfying the perceived needs, a state of equilibrium was attained. On the other hand, the mercantile ideology of the new dominant class in Europe (in the 16^{th} to 18^{th} centuries) used science more and more as an instrument to develop its own power through the worldwide exploitation of nature. Or, to cite Needham:[8]

> "Interest in Nature was not enough, controlled experimentation was not enough, empirical induction was not enough, eclipse prediction and calendar calculation were not enough, — all of these the Chinese had. Apparently a mercantile culture alone was able to do what agrarian bureaucratic civilization could not — bring to fusion point the formerly separated disciplines of mathematics and nature-knowledge."

Thus particular internal features (*e.g.* the fusion Needham refers to) are influenced by particular cultural (in this case socioeconomic) factors. The socio-culturally induced *values* (*e.g.* mercantile moral values) have to be taken into account in the discussion of relativism.

This interpretation of cognitive relativism in the debate on the status of scientific knowledge is interesting, since it situates science as a way of thinking and acting in the very broad context of one or more civilisations. Hence, the different questions we asked can be seen as operationalisations of the encompassing concept of civilisation. Of course, this reveals our particular perspective of the notion of civilisation: we use it to function as an analytical concept, which allows us to think of a variety of habits, concepts, attitudes and material products as belonging to one set. The set is to be understood as a temporary circumscription of the way a particular population (*in casu* the people living in a certain geographical area) orders its communication and interaction with its natural and human environment. To be sure, the set has fuzzy and/or shifting boundaries, and elements of it will be actively used or not depending on the needs a population perceives. We claim it is useful to focus on salient aspects of this vague set, such as

cultural specificity, gender sensitivity and social-political situatedness. We do not claim at all that this list of aspects exhausts the notion of civilisation, but we hold that this particular constellation is not random, since it appears as a constellation precisely in the broad context of the present western civilisation (say of the 21^{st} century): western identity includes such "cultural" traits as religious attitudes and beliefs, a particular interpretation of ethics and conscience, and so forth. Over the past decades, it has also comprised an awareness of gender differentiations, and it is certainly marked by a particular history of ideology, political struggle and colonialism vis-à-vis other peoples and nature. Science has grown and is still situated in that context. We think that this is not merely circumstantial, as the received view of positivist philosophers would have it,[9] but an intrinsic quality of science. Science is a practice and a product of human beings, so that its situatedness should be recognised. To sum up this point, we argue that both cultural intuitions (in the West drawn from religious cosmologies primarily) and socio-political contexts should be taken into account. The latter needs a closer look.

Science is produced, developed and organised in a social, historical and political context. Our point is that this contextualisation or situatedness of science has an impact on the status and on the contents of the knowledge produced. Again, we do not take a relativistic stand by claiming this, but we clearly criticise a merely internal or disciplinary view of science and knowledge. We elaborate this point by focusing on social sciences in general, and on anthropology in particular. The arguments we advance refer to a shift in thinking about citizenship and personhood in the history of social and ethnographic knowledge and about their present status and contents in the globalisation trends individuals and societies are subject to.[10–13]

As social scientists we study human beings, groups and societies in the conceptual framework that appears as valid or obvious in the present era. It suffices to search for the historical roots and/or for the cultural particularities of these concepts to become aware of the contextuality and the situatedness of what appeared as obvious. One important way of looking at human beings in our society is by focusing on the individual as a citizen. Even a short analysis of the concept of citizen in European history is revealing. In a previous study we started to map the present format of citizenship against the background of initial forms in the medieval cities of Flanders from the 12^{th} to the 15^{th} centuries.[10] There an experiment was set up to shape sovereignty and political representation in the attempts

of the cities to free the burghers from the bondage of clerical and profane rulers. Historical analyses of this fascinating period abound, detailing how self-governance, representational election in councils and the investment in freedom and lawfulness gradually supplanted the theocratic and undemocratic rule that was in power for centuries.[14] Cities started designing their own idea of humanity, of society and of economy over a few centuries. With the emergence of the Habsburg Empire of Charles V, a devastating restorative regime was put in place, which replaced all acts of freedom and sovereignty by laws of obedience to one emperor, one church and one narrow view of humanity. The freedom of the cities was crushed or reduced, and the experiments in democracy and independence were smothered by the brutalities of religious strife. It took Europe several centuries to overcome this tragic setback and to resume the path of freedom and democracy. In fact, it is only with Enlightenment that the programme of devising a human being free from bondage and able to take his destiny in his own hands became thinkable again.

The American and the French Revolutions can certainly be seen as historical markers in this sense. They signify in a clear way the trend of growing freedom and sovereignty in the West. In the words of the French political scientist Touraine, we can state that negative or restricted freedom became a main feature of the western citizen in this recent history: citizens have viewed themselves as free from bondage ever since. With these two revolutions and the philosophy of human rights that shaped the nation states in their wake, human beings in our part of the world came to see themselves as creators of their own society based on mutual respect and reasonable agreement according to the values of freedom, equality and fraternity (or solidarity). The ascription of such values as basic to humanity is, by all means, a recent development (*i.e.* at the most some 230 years or 10 generations), and hence cannot be understood as universal or "natural" in any sense. Moreover, the gradual incorporation of such values by individuals in the West and their pronunciation in institutions has them changing and shifting over time. The notion of freedom is now transforming into that of "integral freedom":[15] being free from bondage implies a negative program, but does not tell one how to proceed in such a way as to organise maximum or optimum freedom. It does not prescribe anything to the effect that an integrated societal project comes to life, rather than a new jungle (see also Ref. 16). Touraine diagnoses that integral freedom came to the fore in the '60ies of the past century, when a free citizen emerged contesting church and state in an unprecedented way. Equality was refined

along the way to cover a content of equality of rights and/or equal opportunities. Brotherhood or fraternity was dropped for the institutional term of solidarity, at least in Western Europe and after the Second World War.

At a global level, a recent deep revolution is shaking the very foundation of our notions of citizenship and humanity. What is often termed "globalisation" (or mundialisation in some postcolonial discussions) appears to be of a different nature than anything we have known before. Hence, the kinship between "empire building" of the times of Charles V and the Habsburg rulers has little to teach us about what is happening in the present era.[17] In our view, the very Enlightenment notions of human being, of society and of citizen are up for reconsideration now.

2. The Contextual Constraints

Social sciences and the humanities are under attack in the most advanced countries of the world. The most famous scholar on the development of the information technology and its profound impact on the social and political processes and structures of the world is M. Castells. His "magnum opus" comprises three volumes, and sketches the basic feature of the emerging network society, the decline of the nation state structures and its power balance, and the concomitant growth of identity movements and counterpower in a rapidly globalising world.[12] In line with Touraine, he points to a radical and deep change in the new citizens of today's era: the well-to-do variety of citizens are free of bondage and seek their identity through internet and international networking rather than through family role models or religious ideals. On the other hand, the larger part of humanity is not sharing in this way of life, or not yet. The crucial point is, according to Castells, that in this world of the third industrial revolution — which he has dubbed the "information age" — knowledge and creativity constitute the real locus of creation of wealth. As a citizen, you either have access and abilities to partake in the acquisition and creation of knowledge or you do not. The third industrial revolution took us by surprise: the established society, nor the notions of loyal citizenship and canon-bound education and socialisation were prepared for it. This explains the advantage of cutting-edge cultures such as modern-day California, and the handicap of "old" mentalities exemplified by hard-working, thoroughly structured industrial societies such as Germany or Japan. The relevance of this point for the present analysis is hinted at in a later publication by Castells:[18] he expresses his amazement at the growing attacks on the humanities and the

social sciences in major western countries. At a moment when creativity and capacities to play around with the new technologies are clearly great assets to create wealth, the humanities and social sciences would obviously become the most important branches in the science panopticum. However, in the restorative mentality displayed by several governments (from the USA over the UK to The Netherlands and Belgium) one recognises deliberate policies aimed to reduce the curricula and research opportunities of these disciplines. In a sense, the ideal of the policy-makers remains that of the engineer and the computer hardware, which only provide the necessary tools (much like the second industrial revolution did), whereas the producers of contemporary wealth are demonstrably those active in the realm of humanities and social sciences who are creatively working with these tools. A unique example is a country like Finland, where the combined inspired efforts of a first-class university, a major technological firm and a visionary government successfully promoted art education and creativity of all sorts, bringing this little country to the top 5 list of wealthy nations within a decade. It managed to surpass its traditional competitor Sweden, and most of all Germany, a country that remained within the old mindset. These developments are profound, irrevocable and most powerful. It goes without saying that they have a tremendous relevance for social sciences and the humanities: they address them in a very direct and deep way. Indeed, these disciplines cannot continue to study human beings the way they did before. Human beings and society take a central place in the present human condition. This implies that both the objectifying view of the positivists and the false subjective stand of the phenomenologists are obsolete. The man–machine analogy of the old positivists is obsolete, because the human condition and the life expectancy of humankind are determined through creative manipulation and imagination with the aid of equipment. In a very intriguing sense, the virtual is becoming "reality". For one thing, we have to overcome the idea that the virtual will be understood as another form of the real, and pass on to thinking of the virtual in its own right. The phenomenologist, on the other hand, could only think of the other (within his own or a different gender, culture or religion[19]) as a replica of the researcher, in the sense that, in this school of thought, human beings would be understood adequately to the extent that they could be conceptualised within the researcher's framework of reference about his own self. It is clear that, in the present era, this perspective restricts all creativity and potential to the constraints of the person of the researcher. Hence, both the positivist and the phenomenological perspectives express

a unidirectional or one-sided view of human and social realities: in both epistemologies the researcher is the only one who determines the categories, which are deemed relevant or salient for social and cultural realities. In today's decidedly mixed world (in terms of gender, culture, religion, *etc.*), this is an extremely parochial view. If we push this critique one point further, it will be clear that science's perspective of humankind has to shift, in order not to be stuck in narrow-mindedness and exclusion: we need to become open to multi-level and varied ways of thinking, behaving and creating, and this will only be feasible if we conceive of psychological, social and cultural realities in a different way. We can only develop dependable knowledge about human beings in and through interaction with them: concepts, categories, meaning, sense, cultural and religious contents and everything else which makes humans the creative agents they prove to be, can only be understood in a "scientifically salient" way to the extent that we can reach such knowledge through interactive processes of observation, communication, negotiation and control of the results, which should be a joint venture of researcher and subjects.

This point was elaborated brilliantly by Bourdieu in his praxiological work.[20] It is taken to its practical consequences in his later analysis of the scholastic point of view.[13] There, Bourdieu points to the academic attitude, which urges social scientists to engage in quasi-theological debates and publications, sticking with scholarly criteria of scientific correctness and disciplinary rigidity and disqualifying so-called external parameters (like the contextual parameters we are illuminating in this essay). Of course, scholars are able to play this game. If science policy-makers emphasise this perspective by forcing the positivistic criteria of the natural sciences upon young scientists as a means of career building (*e.g.* by using the ISI system as a main parameter in evaluations), then the "scholastic attitude" gets a serious boost: the young scholar quickly learns the name of the game and specialises in purely scholarly analysis, in "thin" analysis (to paraphrase Geertz[21]) and in decontextualised and politically correct research proposals. Bourdieu warns against this development: the result will be that the humanities and the social sciences speak about their own backyard in a scholarly trained way, but without any relevance for, let alone any critical impact on the real world. One can take a political stand and argue that this view of the humanities and the social sciences will be self-defeating and harmless (and thus "politically correct"). In the view presented here, we claim that this perspective is out of touch with social and cultural reality. In that sense, the view is harmful. Knowing that it is promoted through

policy-makers, we can only conclude that the social sciences and humanities are indeed under attack in the present era. In the context of their objective relevance and importance in the information age,[12] this development should be forcefully countered.

3. The Civilisation Debate and the Study of Humans

One final piece of the puzzle can be added here, landing us squarely in a debate which is impacting on the future of humankind. When the political scientist S. Huntington launched his book *The Clash of Civilizations and the Making of a New World Order*,[22] very few social scientists or scholars from the humanities felt that they were addressed by it (one of us did[23]). In a recent article, U. Hannerz makes this point.[11] Hannerz invites anthropologists to reconsider the basic notions and the status of their discipline in the light of the recent changes in the cultural and political world: globalisation brings about a new debate about the role and status of culture. Anthropologists should situate themselves and offer the expertise they have in this debate. And until recently, they hardly did. Nevertheless, both globalisation discourse and the political stands of the "new" extreme rightist parties in the world wish to make the notion of culture the centre of debate. In his intriguing article,[11] Hannerz offers an overview of positions vis-à-vis the status of culture (and hence of anthropological research). The overview offers a frame of reference which will allow us to look at the role of anthropologists, but also at the role of culture as a parameter in the contemporary globalising world. The perspectives he distinguishes either state that the world is becoming culturally uniform or not, and the view that the world is culturally changing in relevant, but gradual ways. The latter view is called the "transformationalist" perspective of globalisation: all cultural patterns are changing and shifting, but these changes are gradual. The view of Huntington, claiming that civilisations will close and essentialise, and will fight each other as monolithic cultural blocks, represents what is happening in the world in a rather one-sided and opinionated way. Looking at social sciences as situated knowledge, one can ask what benefits social scientists can draw from such a conflict-inducing perspective of civilisational developments. Anthropologists in particular have been detailing a tremendous multitude of small shifts and gradual hybridisations around the world: no society remains the same, and both larger communities (called "civilisations" by Huntington) and smaller societies adopt traits and behaviours from each other, inducing a totally new dynamic of overlapping and hybrid

interacting groups. In line with Bourdieu's invitation to break out of the scholastic attitude as social scientists, Hannerz calls upon the anthropologists to regard themselves as responsible researchers in a transformationalist perspective of globalisation: they are uniquely placed to inform on the ways the micro and the macro levels of identity and agency dynamics work in unison in the present-day world of globalization. The complex dynamics we see while adopting this perspective is that of a world which grows denser and ever more interdependent. Taking the stand that cultures or civilisations have to return to their "essence" can best be characterised as a hopeless attempt at "cultural fundamentalism".[24] Such an attitude, a kind of cultural counterpart of religious fundamentalism, is typical of extreme rightist political movements and aims at confrontation and war based on claims of identity. The transformationalist perspective, on the other hand, is that of a world of constant shifting and mutual borrowing that is increasingly becoming culturally hybrid. In such a perspective, overlaps and links are undeniable, stressing the importance of means to cope with diversity and change and characterising confrontation and war as failures of intercultural interaction.

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SCIENCES AND KNOWLEDGE PRACTICES: THEIR CULTURE-SPECIFIC WELLSPRINGS

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Sensitive to the calls made by Anthony Kwame Appiah, Jean-Marc Ela, Paulin Hountondji, Joseph Ki-Zerbo, Ali Mazrui, Ngugi Wa Thiong'o, and Okot p'Bitek for adapting education and research activities to the polyvalent African contexts, I will examine some dimensions of the as yet poorly understood relationships between Western sciences and endogenous, site-specific or local knowledge practices in Black Africa. By local knowledge, I mean any culture's unique genius and creativity characterising what its members in their singular context and history meaningfully develop as knowledge, epistemology, metaphysics and worldview.

Keywords: sciences, cultural embeddedness, endogenous knowledge practices, polylogue, black Africa

1. Introduction

Involved in university collaboration and anthropological field research in Black Africa since many years,[a] I have been very sensitive to the calls made by Anthony Kwame Appiah, Jean-Marc Ela, Paulin Hountondji, Joseph Ki-Zerbo, Ali Mazrui, Ngugi wa Thiong'o, and Okot p'Bitek for adapting education and research activities to the polyvalent African contexts. From this plural horizon, in this article I will examine some dimensions of the as yet poorly understood relationships between Western sciences and endogenous, site-specific or local knowledge practices. All knowledge is first of all

[a]I am referring to my experience, first as a student in philosophy and later in social anthropology in Kinshasa, the Congo, from 1965 onwards, and subsequently to my immersion as an anthropologist, alone or in the company of doctoral students, in various communities in Cairo and Tunis, SW. Congo, N. Ghana, S. Nigeria, S. Ethiopia, SW. Kenya, NW. Tanzania, S. Africa and NW. Namibia.

local knowledge.[1] By local knowledge, I mean any culture's unique genius and creativity characterising what its members in their singular context and history meaningfully develop as knowledge, epistemology, metaphysics and worldview. Knowledge originally develops from a culture-specific wellspring in a vernacular language-sharing group and in line with its ontological order and epistemological tradition. Such a plural stance and sense of the infinite ways of being and knowing, without homogenising the plurality or mastering the divisions, echoes the true cosmopolitanism advocated by Pollak, Bhabha, Breckenbridge and Chakrabarty.[2]

To examine the mutually enriching relationship between Western sciences and culture-bound or local knowledge practices,[3] I will first draw on a few recent studies on vital kinds of knowledge-building, such as the programmatic studies undertaken by, or in line with, *the Subaltern Studies Programme* at the Delhi School of Sociology,[4] or those launched by the periodicals *Public culture* and *The South Atlantic Quarterly.* I will also draw on some so-called Orientalist studies to examine how philosophical, religious, psychological and mathematical notions from classic Arabic civilisation, India, China, and Japan have been incorporated into Western thought from the 16^{th} and 17^{th} centuries onwards.[5–11] Secondly, I will discuss some Arabo-Islamic and Southeast Asian scholarly traditions and institutions that have relentlessly tried to contextually adapt the adopted Western intellectual traditions to their own genuine ones. Thirdly, this article will focus on the by now classical debate on *Black Athena*[12] as well as on the *African Renaissance.* The latter was originally formulated by Cheikh Anta Diop and has now been reformulated by president Thabu Mbeki to cast off Africa's apartheid and post-colonial intellectual servitudes, as well as to assert the genuineness of African civilisation and to bundle the multiform cultural manifestations within the many local communities and social movements, in particular the suburbs, throughout the Continent. Parallel to this, others are making an effort to point out the various versions of *Afro-modernity.*[13,14] Indeed, many African groups all over the continent deeply resist both the all too compartmentalising and techno-rational strands of Western science and the hedonistic, consumerist life-styles instigated by the globalising capitalist economy and mass media.

2. Plural Modernities

It seems paradoxical that, parallel to the present phase of economic and informational globalisation, Western civilisation should be losing its appeal

to the South, where it is taken less and less as a standard for social modernisation and cultural emancipation.[15–19] Be that as it may, an increasing number of populations feel expelled from, or disrupted by, the new political, military and economic World Order of the so-called "superpowers", and seek to distance themselves from the imperatives of this World Order on the grounds of their own social, cultural or religious nature.

Like the former Soviet States and so many other subaltern populations, most Black African nations have no say or influence whatsoever in international political decision-making nor in military and economic hegemonies. They are also excluded from capital-intensive developments in managerial or techno-science and higher education, giving rise to a grim worldwide socio-economic exclusion or marginalisation. This underdevelopment expresses a particular relationship of exploitation of one group or country by a stronger one, dislocating individuals, groups or societies from their own civilisational core while depriving them of the benefits of their natural resources and labour (in an imperialist, capitalist, colonialist, technocratic, informational or other relationship of unequal power and exploitation). Underdevelopment is often a marked paradox. Indeed, people in many peripheral parts of the world (totalling some 75 percent of the world population), including descendants of grand civilisations or people living on naturally rich soil, are actually voiceless on the world scene and poor or powerless in the world market, whereas regions in the centre that are not so well-off in cultural resources or rich (sub)soil are enjoying the highest standard of living (80 percent of the economic capital is concentrated in 20 percent of the world population).

In terms of labour distribution, the industrialised countries are on the eve of a transition to post-industrial production setups centred on the so-called immaterial tertiary sector, which is characterised by intricate information processing and worldwide promotion of ever more encompassing exchanges. On the political and socio-psychological level, we can see how, with the Cold War and East–West polarisation having come to an end, the nation-states no longer have any external, easily identifiable scapegoats for their political and psychological channelling and shifting of violence *ad extra*. Simultaneously, the 1990s witnessed unprecedented outbursts of internal social violence in East European, former Soviet, and young African states. Conversely, the sophisticated military interventions and relief operations conducted by the superpowers and the United Nations appear increasingly incapable of suppressing internal or local conflicts, conflicts that, moreover, are partly made possible with weapons supplied by the North.

Nor do they seem to be capable of stopping the terror of (para-)military gangs or reconciling the parties concerned. Nor do they succeed in averting the massive flows of refugees, or in permanently integrating the ever-increasing numbers of people on the run or housed in camps in the host countries or in their own home countries. In places where multinational corporations exploit the riches of uprooted countries, international politics enters the scene to extend a top-down approach of arbitration.

On their part, local populations seem more and more inclined to develop or reaffirm a myriad of modes of being and hence unbound, multi-centred forms of cosmopolitanism. Since the 1990s, for instance, many suburbanites in the megapoles of Africa, South America and Southeast Asia have lived beneath the line of abject poverty. Particularly women, who are heading most households today (by managing to eke out a survivalist existence on the slim profit margins of street vending), seek to resist the globalising, individualist and consumerist models from the North. In particular in Black Africa and South America, they mobilise mutual support in the contexts of their social movements, post-missionary Christian prophetic healing churches or local action groups, including support at birth-giving or funerals, or for ensuring a minimum level of hygiene, or again for keeping out burglars from the neighbourhood. Women are setting up these movements parallel to activities of the community councils of elders, local credit associations and communitarian healing and funeral practices. Also, by parodying the Christian liturgy and its salvation mission, they defy, transform and re-appropriate the highly moralised views that have traditionally denigrated their backward peasant origins, their community lifestyles and ancestral traditions in the name of reformist modernisation, economic development and emancipatory Christianisation.[20–22] For example, having interiorised these prejudices, many African emigrants moving from supposedly backward villages to suburban districts have ever since been torn between the traditional ethos of kinship and solidarity and a fascination with modernist civilisational tropes concerning the White diploma,[b] instrumental rationality, individual entrepreneurship and White development, on the other. Through social movements and healing churches, they cross-breed endogenous values and ideals of community solidarity, elderhood, belonging

[b] A recent and steadily growing literature on "white" school education in Africa South of the Sahara questions the asymmetrical relationship that was brought about by the coloniser, instilling a durable, receptive or passive disposition in relation to Western knowledge. Among the many numerous works, we should mention Refs. 23–32.

and a common sense of duty. They mirror themselves in the imageries of transnational TV programmes, and engage in the very diverse horizons of Western school education, Pentecostal churches, nationalist political discourses, meanwhile trying to cope with deficient public transport and community healthcare services, overpopulation, the grim threat of AIDS and the military. Indeed, in Black Africa these social movement versions of Afro-modernity hint at a profound nurturing and epistemological link between ecology or "oikology" and cultural re-origination. This Afro-modernity is thus, on the one hand, centred on the local communities' search for "homecoming", cf. *oikos*, in the townships across the African continent. On the other hand, it ties in with their search for a re-origination of social bonds and cultural values from within the innermost resources and primordial models of their community and culture.

3. From a Universalist Science Perspective to a Rhizoma-like Perspective

Current trends in radical ecological and feminist thinking[33,34] and other fields were inspired by the Subaltern Studies Programme at the Delhi School of Sociology. Like other culture-sensitive socio-political and ecological approaches,[35–38] they invert the relation of subordination between so-called tradition and modernity. They also overthrow the subordination — brought about by the (post-)colonial and liberal economy — of the communitarian celebration of a sense of plenty and regenerative potency to economic and cultural rationality, bureaucratic state power and the authority of the elders, economic profit-maximisation and community solidarity, the satisfaction of individual needs and the cult of individual competition. There is a growing plea for the revitalisation of multi-centred sites of plural, endogenous or local knowledge practices.

Since the 1980s, the influence of the modern bourgeois ethos and appeal of secularisation proper to Europe's rational era of the 19th and 20th centuries, which saw an enormous expansion of modern university sciences, has waned among many subalternate cultures. Psychoanalytical, feminist and post-modern trends in the humanities and in the public debate, whose supporters include a great number from among the displaced or immigrant groups in the North, help undermine the Western mode of linear evolutionary thinking. They denounce the sources and excesses of violence, destruction, negation or exclusion in the civilisation project of the West, as it leans too heavily on the logic of scarcity, the feasible, Progress, and on

the self-development of the rational, sovereign Subject.[23,28,33,39–42]

The high-modern civilisation has legitimised, from its own perspective of supposed superiority, a hierarchical, dichotomising and violent polarisation of our outlook on the world, society and man. As nowhere else in the world do the Hebrew heritage (with its patriarchal and demiurgical concern with order, lack and restoration) and the Hellenic heritage (oriented towards separation, taxonomy, reason and Promethean self-emancipation) in modern Western civilisation place the notion of culture qualitatively above nature, science above endogenous or local knowledge systems, man above woman, white man above coloured man, man above animal or plant, reason above emotion, psyche above soma, and objectivity above subjectivity. Likewise, these same heritages place measurable causality above the indeterminate play of forces and energy, needs above desire, the civilised above the primitive, rule or domestication above the irrational or wild, profit and techno-scientific logic above the human value and the common good, economy above ecology, economic laws and the arms race above both the concern for a durable ecosystem and sustainable biodiversity, as well as above a basic ethical order and basic human and community rights. Consequently, institutionalised labour is rated above the unemployed and marketless, working time above leisure time, and rights, competence and competition above generosity, benevolence and solidarity. Feminist authors here discern a struggle for power and authority in favour of the cult of endless competition and aid offered. Man, zealous to subject and control via representation and measurable or mechanic manipulation, seeks to domesticate his life-world and the creative and regenerative forces into something that can be moulded along the standards of masculine and control-driven observation. This set-up subordinates interpersonal and ecological solidarity and the heterogeneous, the other, the irreducible, the indefinable, the indeterminate and the creative, to the feasible and the uniform, that is, to a homogeneous, empirical, measurable, intelligible, determinable order that can be manipulated. Diversity and complexity, understanding and meaning, become subordinate to measurability and verifiability, i.e. to rational knowledge and instrumental functionality.

4. The Local Knowledge Systems and Practices

The notion of local or endogenous knowledge production entails an epistemological shift. It stems from the awareness that vernacular, site- or community-specific knowledge ties in with the grammatical and lexical

structures of the given language, the local cosmologies or worldviews, whether religious or not. In its turn, this multi-polar or multi-sited view of culture-specific knowledge production should enter a dialogue with the universalist stance and some of the essentialist fixities of modern science.[43]

Note that "endogenous/local" does not primarily refer to space, locality, spread or diffusion, or to ethno-cultural roots or political and economic boundaries, or to any presupposition of some fixity or homogenised cultural realm. The emphasis is placed on plurality and on knowingness, on someone's culture-specific and communal capacities to perform. Through the learning and sharing of experience and method, culture-specific knowledge produces its own experts. Rather than spatialising experience, the notion of "endogenous/local" implies a focus on the source and authorship of knowledge practices (the position, rooted-ness or inclusion of the subject in an ongoing engagement with contexts, such as, the city, dialogical networks, global trade, and techno-science). The focus should not be reduced to nostalgia for ways of life and knowledge thought to be traditional and therefore authentic. Room must be made for a multi-dimensional, rhizoma-like model with discontinuous, multi-stranded, interpenetrating subspaces and entanglements.

4.1. *Anthropological Perspectives on Local Knowledge*

4.1.1. *Parameters of local knowledge*

Let us first try to offer a definition of local knowledge in order to identify some of its parameters. Given the particular historical North–South context, heir to the recent colonial endeavour, it is inevitable for local knowledge to be situated in relation to the dominant scientific tradition in the West or the cosmopolitan, but this is not intended to be an essential opposition. Any polar juxtaposition of the two would be unproductive in terms of our understanding of knowledge systems and sciences, precisely because we suppose them to be plural.

Local knowledge refers to a vernacular community's distinctive modus of understanding, as well as to its values and practices for shaping and filtering, concealing and revealing (both sensory and cognitive) experience, as well as for authoritatively communicating or storing it. A *knowledge-based* and *knowledge-producing community* may in its festive celebrations and transition rituals re-appropriate, re-orient or re-embrace its basic culture-specific postulates or presuppositions. Marriage negotiations, funerals or various notions (such as honour, ancestors, authority, parenthood

and motherhood, or even the future, industrial revolution, urbanisation, progress, migration, nature, the real, rightness, fullness, weakening, misfortune and illness) may all underpin the collective imagination and activity and act as a primary orientation for it.

In community, professional or other stable networks, local knowledge is *mediated* through the people's particular understandings of shared, context- or group-specific experience, and through their strong links to their particular sources of knowledge, such as ancestral words, ritual speech or stylised dialogues. Displaced people, on the other hand, may develop and celebrate, from within their speech community, resistance and multiple identities in what has been called a process of creolisation or pidginisation (*diversalité*, as French-speaking colleagues say). What is produced in response to this sort of alienation is an imagined pluralism, or patrimonialisation through folklorisation.

Such endogenisation parallels other forms of newly found cultural assertiveness evident in many African communities and urban networks. Examples include the re-valuation of local people's visions of nature, environmental knowledge and management of biodiversity, pharmacopoeia, illness etiologies and healing arts. Other examples are the communities' reaffirmation of chiefly authority and customary jurisdictions, and the recycling in towns of craftsmanship, such as pastoral and agricultural calendars and arts in the rural worlds, along occasional cases — possibly under the influence of tourism — of the revaluation of local cuisine, music and folklore. The prestigious Chinese, Ayurvedic, Balinese, Japanese, Amerindian, Arabic, Hausa, Bantu and other civilisational traditions are more and more affirming, also beyond their own spheres, their specific epistemologies, classificatory grids, and cosmologies, and their ethical and ecological concerns. Such increasingly forceful cultural assertiveness, in many parts of the world, ties in with the strong nationalist and ethno-regional reactions against a neo-capitalist and informational globalisation. In this global pattern, capital operates in an even more footloose fashion, in particular where it is linked to computerised informational technologies and circulates around the globe in ceaseless electronic flows of virtual money.

Paradoxically, colonial and apartheid ordinances have stigmatised — precisely in order better to reject — local activities, idiosyncrasies and so-called customs as *negativity*, as antisocial, as static, as idolatrous or irrational, as a void. Colonial power established itself by localising, tribalising and thus miniaturising societies and cultures. Local societies were stamped as tribal, simple (homogenous) and unchanging, and thought of as

possessing only local units of native language, culture, self-identity and religion. Localism has functioned as a correlate to the colonial invention of the native, the underdeveloped, the rural, the uneducated, and in some cases, as the locus of the resistant, the rebellious, the authentic, the spiritual, rendered exotic through romanticisation.

We should avoid fixating the concepts *local* (evocative of the colonial or modernist-reformist associations of native, rural, pre-industrial, traditional, pristine, tribal or ritualistic) and *(self-)identity* (whether social, ethnic, national, authentic, intracultural, religious or economic). However, my emphasis on knowledge construction from below and from the periphery is an implicit denunciation of the truth or orthodoxy claims that are made from above and from the centre to universal legitimacy through any number of modernistic entities and colonising procedures such as the supposedly civilising mission of colonisation, literacy, mission work, university sciences; or of the nation-state, the national language, present-day mass tourism, the mass media or the geopolitics of arbitration. Similarly, the current globalising economy and financial flows impose on the modernising peripheries — in particular through management, TV and advertisements — their global stage of competition over goods that are thought to be limited, such as land, housing, money, wealth, status, political decision-making and cultural authenticity.

Local societies and cultures and their knowledge practices, however, have always been complex, pluralistic, multi-layered and dynamic realms of economic, political, social and religious change. They have always entailed contradiction and contestation; dislocation and (interregional) regrouping; innovation and remarkable powers of adaptability; counter-ideologies and symbolic resources of criticism; and they have demonstrated to contain vast reserves of resistance and response to economic upheavals or the trauma of war. These are the kinds of resources local societies have exhibited in confronting widespread ecological crises and epidemics. They continue to inform people's dealings with modern urban society and the unsettling effects of global commodification and liberal capitalism, global literacy and global religions. At the same time, I should also avoid dissolving the incommensurable originality of local languages, insofar as they support local cultures and local forms or modes of agency, vis-à-vis the unifying claims of science, Christianity, the state, the idioms of geopolitics and the international mass media or informational simulacra.

4.1.2. *Placing local knowledge and the dominant scientific tradition in perspective*

In line with Walter Ong, Jack Goody argued that widespread literacy has brought about a cultural mutation in the encoding, storing, and transmitting of knowledge.[44] This mutation has profound consequences for the recognition and mobilisation of local knowledge.

In cultures of *oracy*, communities share their knowledge in very practical, community-based, interactive and multi-sensual transactions. Oracy is very dependent on the participants' culture-specific bodily dispositions (also called *habitus*), culture of speech or rhetoric, and (gender, status, role and age-specific) styles of communication. Oracy anchors memory in the (rhythmic, performative and ritualising) body, and in particular in the heart as the source of sentiments and morality and the seat of both secrecy and opacity with regard to the collective memory and social interpretation of life-events. Oracy favours figuration, a recognition of polysemic reality informed, often unknowingly, by metaphors.

Contrary to oracy, *literacy*, at least alphabetic or linear writing, requires a *techne* that anchors knowledge in observation or vision of the text lastingly offered to scrutiny. Writing also produces a distancing representation of the ideas in line with a more solitary and critical interaction with the text and its claim to authority. One thinks of the distancing representation so prominent in the Calvinist interaction with the bible and the divine signs of predestination. It resulted in the rupture between Catholic traditions (literally voiced along the lines of church hierarchy), on the one hand, and the dialogical, critical scrutiny of the divine will and matters of faith in a Calvinist reading and writing interaction with the biblical texts and divine message, on the other. In sum, literacy has favoured an essentialist dynamic of literalisation in which knowledge became equated with the mirroring or "re-presenting" of reality.

Today, *techno-science* and the massive power of the conjoined media and international capitalism inform a great deal of formal intellectual endeavour. With its emphasis on procedure, it promotes a formalisation of methods, operations and prospects, and leads to a homogenising order as techniques of government, in knowledge building and in science management.

4.2. *Towards Dialoguing with the Plural Endogenous or Local Culture-bound Knowledge Practices*

Can science, if not rooted in the local cultural heritage and social fabric, be at all a liberating force for a community which, for example, is entangled in a daily struggle for survival?

To become involved in a dialogue with the plural endogenous or local culture-bound knowledge practices, and with the endogenisation of scientific practice, requires a fundamental shift of mental decolonisation, on two levels. Firstly, by bringing endogenous knowledge systems into the university curriculum, a shift is attempted away from a homogenising situation of extraverted and dis-located learning and research, such as is typically practised in many universities in the postcolonial South. The prevailing educational mode is largely oriented towards the extraction of data and knowledge, via the brain drain, thus reinforcing, if not creating, a total dependency on exogenous university models as well as on imported textbooks, laboratories and libraries.[45,46] Secondly, it requires an effort of revalorisation, re-appropriation and partial re-invention of local paradigms.[47–49]

This dialogue should also lead to a more insightful anchoring of university science in the cultural heritage of the North. Conversely, the various systematised knowledge systems of grand civilisations should be included in the curricula of our universities.[26,50–53] After all, many students in the North ask themselves questions about the place of such issues as gender-sensitive aspirations and perceptions in the practice of modern science or university policy. What can be done with the stereotypical view of woman or minority groups, what about the underprivileged, Human Rights, Community Rights, the environment, or the sense of progress in knowledge which is not imbedded in a societal ideal? Such a deepening exchange, associated with an ethical and non-hierarchical quest for reciprocal symmetry, coming from plural centres without hierarchical circumferences, seems to us a condition for the creative communication between peoples, indeed even for their survival, within the current globalisation processes and the North–South confrontation.

Secondly, the endogenisation in both the North and the South, namely the partial and self-critical imbedding of the scientific and university enterprise in the social and cultural fabric, will have to gradually yield a new legitimacy and normativity. Given the current theoretical and thus ideological crisis in the (social) sciences, a major problem concerns the foundation and normative reference of institutional action (including university action)

in our technocratic world and its totalising view of the world. Indeed, we are witnessing how strongly uncentred and culturally uprooted/uprooting technocratic knowledge and institutional practices undermine any institution-building action and at the same time create pockets of hegemonic power that reduces plurality.

It is basically no longer acceptable, for *oiko-logical* rather than for socio-political reasons, that university training and scientific research institutes should continue to relegate vital local cultures and practical knowledge to a marginal role. Local cultures and knowledge systems are part of the creative heritage of humanity, and are often the cradle of self-determination. As bearers of considerable oikology, cultures keep us alive, and feed and inspire us, and they are the guides of our self-support, self-rule and knowledge (cf. *logos*), covering basic such needs and issues as air, water, silence, rest, security, vitality or viability, relations, belonging, shelter and housing.

5. Mediating between Local Knowledge Systems

In conclusion, it is necessary to make a somewhat theoretical yet fundamental remark on possible forms of mediating between plural, endogenous knowledge systems — an issue that gives rise to the question of whether it is at all possible to understand, communicate and, ultimately, relate. The problem of mediating between multi-stranded endogenous/local knowledge systems is not only or primarily a problem of translation or interpretation, but rather a problem of *transliteration* of knowledge systems, culture-specific narratives, causal explanations and values. This requires a form of cultural brokering by laying bare the latent organising or all-encompassing, yet open-ended, partly indeterminate theoretical categories, metaphors, practices of control, formations of agency, and processes of becoming or of constituting self-identity or subjectivity. The basic concern I wish to express here as a researcher is one of reaching com-passion with communities of speech, their values and sense of being in control of their identity, however mobile and contingently founded. Such affinities, including claims of multiple selves, are being produced through shifting yet enduring encounters, negotiations and connections. Yet they are neither ever fully captured by these "inter-actions", nor overwhelmed by the many-ness of things.

5.1. *Science Is Not Free of Culture*

Laura Nader,[54] just as Ashis Nandy before her,[4] invites us to avoid the cliché of modern science presenting itself as intrinsically problem-solving, as

a product of laity and pure rationality, as something impersonal, objective, and free from the limitations imposed by local culture and history. In fact, unlike technology, science is a speculative activity: it has its particular cultural and psychological roots. It is the denial of these roots in the name of an impersonal value-free or neutral science which is responsible for many of the ethical and ecological problems in the contemporary undertaking of modern techno-science.

> "By objectifying and impersonalizing knowledge, by de-historicizing the producers of knowledge, one could argue away the imperfect reality of living persons and human history from the world of knowledge". (Nandy in Ref. 4, p. 12)

The social sciences are in a Third World position vis-à-vis the hard sciences (and in particular vis-à-vis the techno-sciences). The referent, i.e. the deeply held beliefs and assumptions, of the hard sciences can be summed up as the breakthrough of Western reformist modernity and the industrialised world produced with the Age of Reason. Some of its values stand out, namely objective knowledge and scientific rationality, which are thought to be autonomous and free from the cultural and psychic compulsions at work in the various spheres of life.

Technology and modernist material progress go on eliciting social hopes and individual aspirations. Linear evolutionist thinking remains a latent presupposition in techno-science's rationalist, objectivist and universalist or metacultural stance.

Techno-science became associated with a particular method, with theoretical knowledge and experiment. According to Laura Nader,[54] the cultures of techno-science or techno-science cultures, i.e. physics, molecular biology, primatology, immunology, ecology, as well as the medical, mathematical, engineering and navigational sciences, all too often draw on mechanistic, physicalist concepts of the universe. The Newtonian idea of a world machine fosters human violence as well as violence to the non-human environment. Through the political events of the last 50 years, large segments of techno-science and scientific discoveries have been turned to military use.

> "The development of science and technology in the West considerably overlaps with beliefs in material and social progress, itself of an ideological nature, for domination of nature has double-edged consequences. ... Science and technology are not necessarily synonymous with social progress". (Nader in Ref. 54, xii)

> "It is an all too ideological assumption that modern science and technology have brought generalised mobility, prosperity, health, security, emancipation and other supposed benefits to human welfare." (Nader in Ref. 54, xiii)

Its techno-rational activity, its bounded and autonomous nature, its homogeneity and its emancipatory effects are often taken for granted. Indeed, with the industrial revolution, science and engineering technologies became the measures of human worth and comparison. Moreover, as key components of the civilising mission, the purported benefits of science have been used to justify European political hegemony in the colonies. However, the unquestioned belief in Western science, rationality and technology has been shaken by the tragedies of Nagasaki and Hiroshima or any recent war, and by controversial ecological and social issues in the domain of genetic engineering.[55,56] In another area, there is a growing risk that the business world imposes its market logic on intellectual freedom in general and on the university, as the privileged locus of learning and research, in particular. In line with Nader,[54] we should acknowledge that the supposed rigour and unambiguity of the hard sciences are not free from illusion when confronted with real world problems of high complexity (also see Ref. 57).

It is of utmost importance to understand that science is not free of culture. Quite the contrary, for not only is it full of culture but it cannot function independently of its practitioners and their vested interests, whatever their claims to a lay status. Pamela Asquith shows how Japanese primate studies, for example, reflect a great interest in ranking and in intragroup and intergroup relations, whereas Western primate studies reflect a neo-Darwinist emphasis on socio-biology, and thus on evolutionary reproductive advantages of specific adaptive behaviour.[58] Western scientific knowledge-building connotes an institutional or bureaucratic setting ruled by the notion of systematised inquiry and ordered rationality, such as financial and intellectual accounting. It is ruled by a group of people united by a common competence; it has erected boundaries and a very pervasive oppositional thinking: science versus religion, rational versus magical, universal versus particular, theoretical versus practical, or developed versus underdeveloped. Science in fact mirrors the compartmentalised societies in which it is embedded.[43] Western science has the tendency to create an image of the other as being inferior or incompetent in order to reinforce its own hegemonic role. Modern Science, with its lack of self-criticism, is often contrasted to the sciences of other civilisations, such as those of China,

India, Islam and the Ancient Civilisations of the Americas. Oldeman examined this issue from the perspective of natural sciences, referring to "fuzzy logic", a concept originating from the Western scientific world.[57] Whereas it was rejected by most Western scientists in a typical oppositional style, this fuzzy logic approach was welcomed in Japan and China, because it suited these cultures better than the current "yes–no" analysis.

5.2. *Charting a New Direction: Science and Local or Site-specific Knowledge Practices and Competences*

One example of site-specific knowledge practices and competences is the age-old phenomenon of local agricultural systems intercropping and using shifting cultivation based on an understanding of the nutrient cycle and the interaction between vegetation and soils, animals and climate.[57,59–61]

It is not our aim to oppose cosmopolitan science to local sciences, but to abandon the sterile separation between science and local/civilisational knowledge systems; to open up to the plurality of valid culture-specific modes of looking and questioning. Our aim is to change attitudes towards vital and experimental site-specific knowledge, to reframe the organisation of science, to avoid a core-periphery model framed as progress. We also aim to avoid obtaining the credibility of science (as autonomous, self-generated, unique, superior) by excluding culture-specific values from its realm. Science's compulsory methodology urging standardisation, uniformity and conformity may not provide the best possibilities for new, vital and cosmopolitan kinds of knowledge-building in the long run.

5.3. *Itineraries for a Relative Endogenisation of Knowledge-building, Partly in Line with the Ambient Rationale of Civilisation*

In order to avoid re-stating such polarities as ethno-science versus techno-science, endogenous, local, traditional knowledge versus universal, modern science — all of which suppose and echo the powerful geographical contrast of the West versus the rest and the local versus global — , we need to lay bare the hegemonic and counter-hegemonic pragmatics of legitimisation, whether they be cosmopolitan, local, built on gender, androcentric, Eurocentric, creolised, commodifying or folkloric. The local/global, indigenous/universal polarity is symptomatic of geopolitical strategies in which a number of knowledge systems and cultures from the centre have become so globally pervasive that they have ceased to recognise their status of lo-

cal knowledge that can be traced back to its original site, and ignore their hegemonic circumferences.

Similarly, the notions of acculturation, inculturation, transculturation, cultural pluralism/syncretism or creolisation have all relied on a spatialising or territorialising view of culture and knowledge. If these concepts have fallen into disuse in current anthropology, it is because they were never free of their moralising connotations. However, we may still want to pay attention to the ways people appropriate and de-originate the externality of what crosses to the inside, and how they diffuse their cultural vitality from their centres, their wellsprings. And, "they might help see that cosmopolitanism is not a circle created by culture diffused from a centre, but instead, that centres are everywhere and circumferences nowhere".[2]

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ON HIGH AND LOW STYLES IN PHILOSOPHY, OR, TOWARDS A REHABILITATION OF THE IDEAL

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In modern culture a "disenchantment of the world", *i.e.* a turn to the ordinary, prosaic and pragmatic has taken place. This development is mirrored in modern art and philosophy with its low, critical-sceptical style and its allergic attitude towards "higher things" and the ideal. The thesis of the article is that in this way important aspects of human experience (in the sphere of care, friendship and suchlike, of scenic beauty, and of morality, spirituality and vision) are marginalised or discredited. The article pleads for a resumption of a (suitably muted) form of high-style thinking in philosophy, art and society.

Keywords: high/low style, uncoupling of reality and ideality, halved image of reality, critique of a one-dimensional concept of experience, rehabilitation of suppressed forms of experience, organicistic philosophy of nature, second reflection

1. High and Low Styles in Poetry

Seven years ago, the Polish poet Adam Zagajewski gave the 1998 Nexus Lecture in Tilburg, with "De vervlakking en het verhevene" ["The flattening-out and the elevated"] as its title.[1] In it, he voiced the conclusion that the literature, and especially the poetry, of the last few decades has been dominated by what he called the low style with its flat and ironic conversational tone. In opposition to this, he made a plea for the high style, in which experiences of beauty and metaphysical intuitions can find expression, and where the sublime, the out-of-the-ordinary, and the mysterious receive due attention. In other words, the emphasis ought once again to come to rest, much more strongly than is now the case, on what has, traditionally, always been the function of poetry: to give expression to the elevated, as well in the everyday as otherwise. What it behoves poets to convey is, "the experience

of the mystery of the world, metaphysical perceptions, the sense of wonder and great amazement, sudden insights, the experience of the nearness of the inexpressible, of that which man may not utter".[a] What we do not look to poetry for, are "sarcasm and irony, critical distance, learned dialectic, and intelligent humor",[b] typical paraphernalia of the low style. Not that there is anything wrong with these things as such, Zagajewski continues, but, for them, we can have recourse to other modes of expression, such as essays and newsprint journalism. What we do look to poetry for, is "a vision, the fire, the flame that accompanies the discoveries of the spirit. Or, to put it another way, what we expect from poetry is poetry".[c] This plea includes a new appreciation of intuition and inspiration as creative forces.

It is of all such things that the world and human existence are very consciously stripped and deprived by the low style with its sceptical-ironic and minimalistic approach. This amounts to an "éloge du quotidien", in the words of Zagajewski's friend, Tzvetan Todorov, a celebration of the everyday as merely everyday. But a consequence of this attention to all that is ordinary, prosaic, and, often enough, banal and vulgar, is that existence itself becomes flat, shallow, crude, and boring, all the efforts of a modern lifestyle — with an entertainment industry deploying ever heavier weapons — to the contrary notwithstanding. The world cannot help but become flattened-out, cruder, coarser (so to summarize Zagajewski's analysis) because what has taken place in modern literature is a reduction of reality. And the only hope of an antidote lies in the resumption of the high style with its openness to dimensions of reality which the low style has at its best ignored where it has not deliberately excluded them from the picture.

But why all this attention to poetry? Why? Because it seems to me to offer an accurate parallel to the state of affairs in philosophy, and not least in the field of ethics. The philosophy of our age is also to a great extent dominated by something like a low, sceptical-critical style.[2] Indeed, one can probably go much further and say that the mainstream of modern, post-mediaeval philosophy as such bears the tokens of the low style — that is, the whole of the philosophical tradition that is the heir to Late Mediaeval nominalism and that constitutes the articulation of the bourgeois attitude to life with its stress on the quotidian and the useful and so of the accompanying image of reality as "disenchanted".[3] Be that as it may, the

[a] Ref. 1, p. 14 (the translation, here as elsewhere unless otherwise indicated, is ours).
[b] Ref. 1, p. 12.
[c] Ref. 1, p. 13.

low style certainly preponderates in twentieth-century philosophy. I cannot resist returning once more to Zagajewski's lecture to quote here a passage which is very telling in this context. He refers to a moving fragment from *My century*, the memoirs of his fellow-countryman, Aleksander Wat. He says,

> "Wat, who in his younger years as a poet was in love with Dadaism, and crazy about linguistic experiments and ludic linguistic criticism, tells [...] about the diametrical change he underwent in the Lubianka Prison in Moscow (in general, you only came out of this prison alive if you were being exiled to Siberia). There, he came to understand that the language entrusted to the poet is extraordinarily precious and vulnerable and, especially in our time, is exposed to great dangers, and that therefore the task of the poet must be the defense of language, and not mocking play with it. This "anecdote", which Polish readers and critics understand very well, has a symbolic value; it draws attention to, and localizes on the map, the parting of the waters between two streams of twentieth-century poetry [...]: between the critical-avantgardist stream that is analytical and suspicious, and the stream which attracts far fewer poets, which will sooner build up than break down, is more ecstatic than sardonic, the stream that seeks what is hidden. For encouraging such reflections, one cannot think of a better place than the Lubianka."[d]

To recapitulate briefly the characteristics which Zagajewski attributes to the two opposite directions after the parting of the waters in the landscape of twentieth-century poetry: building up versus breaking down; ecstatic-visionary over against maliciously mocking, and so, critically destructive; seeking what is hidden in contrast to limiting oneself to what lies immediately before one's grasp (to supply what Zagajewski here leaves implicit); protecting what is vulnerable (in this case, language) contrasted with the hard attack. In short: a positive, open approach versus a negative, critically suspicious one, with the latter attitude very much predominating. And my contention is, as I have said already, that there is an analogous tale to tell about modern philosophy — and modern society. After all, a society gets the poetry — and the philosophy — it deserves.

[d]Ref. 1, p. 23.

2. The Characteristically High Style of Classical Philosophy

But assuming that twentieth-century philosophy at least is indeed characterized by a predominantly sceptical-critical attitude — is, thus, to a great extent marked by a low style — then, by virtue of this fact, we can observe how far this philosophy has come to be separated from its roots. For, after all, philosophy has from the beginning emphatically conceived of itself as having a high style. Its goal is wisdom: insight into the nature of things that, as such, offers a proper orientation to our lives. Take, for example, one of the first Greek philosophers, Xenophanes (c. 570–480 B.C.), who migrated from Colophon in Asia Minor to Elea in Southern Italy, after the Persian conquest of his native land, and who sings the praises of his wisdom as of great importance for the good of the community. In doing so, he criticizes the enormous commotion that is made about the Olympic Games ("a crude popular custom") and their winners: "After all, that ritual lacks any legitimation whatsoever. Therefore it is completely unjust to judge brute strength to be higher than precious wisdom."[4] In addition to the crude popular entertainment of the Olympic Games, the prevalent forms of religion, and especially the human, all too human, character of the Greek gods, are a target of his biting criticism.[e] Here, a higher form of religiosity is propagated on the basis of purified insight. In short, Xenophanes, with his conviction of the elevating working of (philosophical) thinking, can be seen as one of the first enlighteners of Greek culture.

Here, philosophy, by its very nature, is Enlightenment. The thought underlying philosophy, at least in its classical form, is that if one can come to the proper point from which to view things, reality will be seen, ultimately, to be a cosmos, a beautiful and ordered whole, in which everything, including us human beings, has its own well-conceived identity and place. To put it another way, the canvas upon which the richly varied tapestry of the world is embroidered, is thoroughly rational — the principle of sufficient reason is fundamental to the world.[5] Or, to formulate it yet another way, the reality we experience is here conceived of as the manifestation, or the emanation, or the creation of an ideal being. It can, for this very reason, be considered from an ideal perspective. The classical doctrine of transcendentals expressed this in terms of the Real being coextensive with the True, the Good, and the Beautiful. In this perspective, truth and opinion, being and appearance, the good and the reprehensible, are thus clearly

[e] See Ref. 4, fragments B 14–16, to which fragments B 23–25 oppose Xenophanes' own conceptions, 19f.

distinguishable and identifiable as such. It is against this background, too, that the distinct conceptions of human flourishing or, indeed, the good life, both individual and collective, are to be viewed — as ideal images of that human and communal life worthy of the name.

In the whole of this tradition, whether we are concerned with the thought of Xenophanes, Plato, Aristotle, the Stoa, Plotinus, Thomas Aquinas, Spinoza, Leibniz, or German idealism, and of which the ideas of such thinkers as Max Scheler, Karl Jaspers, and A. N. Whitehead can be seen as an afterglow (just where Heidegger — that great chameleon of twentieth-century philosophy — stands, with respect to this tradition, is difficult to say) in the whole of this tradition, to philosophize is, as we have already suggested, to look upon reality from an ideal standpoint, or sub specie aeternitatis, in the light of eternity. Here, in other words, the high style reigns. The lower is interpreted in the light of the higher or ideal. In line with this, opinion is a derivative or deficient mode of truth, nonsense of sense, disorder of order, brokenness of wholeness, contingency of necessity, the finite of the infinite, surviving of properly living the good life, conflict and suspicion of harmony and trust, the ordinary of the extraordinary. In short, the negative is here a variant of the positive.[6]

3. The Uncoupling of Reality and Ideality in Modern Philosophy

To consider such a brief sketch of the perspective of classical philosophy is to see at once how far removed from such a way of looking at things we have come to be. What an epochal change has taken place! — in the field of philosophy, but equally in that of literature and those of other arts, and in society in general.

I share the opinion of those (and they are many) who see this epochal change as starting to take place in the period of transition from the Late Middle Ages to (Early) Modern times. This period (from the fourteenth through the seventeenth centuries) is, after all, the age in which a new type of society, characterized by its own peculiar ways of looking at and thinking about things, its own mentality, emerges. Or, to put it another way, it is in this period that the first great wave of the process of modernization manifests itself, the process of large-scale social transformation that from the mediaeval feudal-agrarian social fabric produces the modern bourgeois, urban civil society. If, with the concept "culture", we can indicate the sum total of the ways in which people behave and conduct themselves, together

with the attitudes and ideas (and their material embodiments) that are characteristic of a society, then we can say that with modern society has arisen a culture that is quite in a class of its own. On the level of consciousness this expresses itself in a new frame of reference that we then see reflected in new ways of representing and thinking about things in the social, legal, aesthetic, moral, religious and weltanschaulich spheres. And so, with respect to the mental and spiritual aspects of the process of modernization within this period, the contours of a new conceptual universe become visible. Philosophy, then, or at any rate the mainstream of philosophy, in the modern period, can be seen as the project of formulating this new vision of reality, of man and society, conceptually, and of thinking it through systematically.

History, including the history of thought, seldom exhibits sharp dividing lines. Alterations of patterns of thought are not fully realized from one day to the next. That is certainly true where the change from the classical to the modern way of thinking is concerned: the process involved can be better characterized as a sort of alluvion, a long, gradual alteration like that wrought by the beating of the waves upon the shore, and it is a process that even in our own time has not yet reached its completion — we are still busy drawing the conclusions inherent in this change. And yet it can be rightly contended that in Late Mediaeval and Early Modern times new mental and spiritual tendencies have gotten to work (or, in effect, tracks have been switched), and that these tendencies are in important respects diametrically opposed in their direction to those of the classical scheme of thought. I think, then, that one can indeed speak of a "reversal of the world" with respect to the direction which our way of thinking has followed from the premodern to the modern period, whereby, to use a mathematical image, the world has had its signs reversed, in comparison to the premodern way of thought — the universe and everything in it, is like a complex formula which has been bracketed and had a sign placed before it under which every element of that formula must now be read differently.

Perhaps the developments which were introduced by nominalism and which receive their further working out in (the mainstream of) modern philosophy, can be most cogently summarized as the uncoupling of reality and ideality. In classical philosophy, as indicated above, the real and the ideal coincide — where the Real in its highest form is concerned, that is — whether we think of the "Being" (Eon) of Parmenides, the world of "ideas" or "forms" (ideai) of Plato, the divine Nature of the Stoa or of Spinoza, the One of the Neoplatonic tradition, or the God of Christian theology and

philosophy. Within this identity of the real and the ideal are nestled all the other theses — that reality is transparent and intelligible, and, thus, knowable; that it is a meaningful whole; that the will is by its nature directed to the good; that peace is the natural state of society — and so on. What, to such a way of looking at things, requires an explanation is, how deviation and error are possible, and where evil, disharmony, conflict, absurdity, and contingency come from — and so forth.

With the uncoupling of the real and the ideal — or, as Nietzsche calls it in his parable, "The Madman" (aphorism 125 in *Die fröhliche Wissenschaft* [The Gay Science]), the uncoupling of the earth from the sun — thinking flips over. What now become problematical are just the matters that before were considered obvious — the knowability of things (if the affinity of thinking and being which is fundamental to classical thought falls away); the possibility of moral conduct (if all behavior is determined by self-interest); the possibility of living together peacefully (if conflict and suspicion set the tone for relations between people, as is the case in the modern idea of "the state of nature", where a human being is conceived of as an individual who is by nature unsocialized, "asocial", and who, first and foremost, constitutes a (potential, at the very least) danger to others — a danger which, according to this well-known interpretation of things, is averted by the creation of a community by means of a social contract, what must in reality always remain an exceedingly fragile, vulnerable arrangement, given that it is based on the unsocial nature of human beings and so can in fact never signify more than an armed peace).

Just as the status of knowledge, morality, and social existence becomes precarious in modern thought, and ever more so in proportion to the extent to which that way of thinking shows its true face, so also is it the case with every crucially important phenomenon in classical philosophical discourse — whether one thinks of harmony, wholeness, beauty, meaning, ideals, a common good, or of such supposedly unassailable values as humanity and dignity, or, further, of such things as the elevated, or noble, or of disinterestedness, integrity, objectivity, or respect for the mystery of reality.

All these concepts have plummeted in value on the modern philosophy exchange, where they have not indeed become quite worthless and been withdrawn, one after the other, from the market. The clearest example is, of course, that of the idea of God or the divine, the center and symbol of the ideal dimension of reality in classical thought. The history of modern philosophy can be characterized as the progressive, and relentless, stripping away of every function from this highest eminence within the classical frame

of reference, leaving, at last, not a rack behind. Descartes needs the idea of God simply to be certain of the reliability of thinking (in saying which I do not mean to say anything about his personal sincerity). After that, there is no further rôle in store for it, and Descartes can (as one of my mentors, S. U. Zuidema, once formulated it) say, "adieu à Dieu". The Deus absconditus of Protestantism, the distant, out-of-work God of Enlightenment Deism, the idea of God in Kant, that, theoretically speaking, retains no more than the function of a regulative idea in the process of the formation of knowledge, and, practically speaking, that of a postulate supportive to morality, that, in short, has become reason's inventory and accessory instead of being the point of orientation that transcends it, all these are so many stages upon the way that leads at last to the projection theories of Feuerbach and Freud (God made in our image) and to Nietzsche's registration of the death of God. And because the idea of God functioned as the cynosure and very center in the classical way of looking at things, clearly, with the death of God that whole perspective with all its key components is also declared dead. Modern philosophy, at the latest since the revolutionary break in the nineteenth century, as Karl Löwith characterizes the turn philosophy has taken from Hegel to Nietzsche,[7] and in a very thorough-going fashion in our own period, culminating in Neo-nietzschean postmodernism, has become terribly allergic to terms such as truth, morality, beauty, totality, and so on; and to talk about God or the divine is wildly eccentric and simply "not done".

With the uncoupling of the real and the ideal, the philosophical wind, as we have already suggested, swings round by 180 degrees: from a pleasant Mediterranean breeze it becomes a raw, cutting blast blowing steadily from an un- (or anti-)ideal quarter and working a drastic transformation of the mental and spiritual landscape subject to it. Many an ideal crop that needs the sun and warmth,[f] withers in this bleak climate, where only the hardiest have a chance of surviving. It is no accident that there is a fascination for the "hard" in contemporary culture (hard science, hard-hitting journalism, people who can drive a hard bargain, hardheaded managers, hard rock, *etc.*) — and, so far as I can see, it is in the changes that we have been considering that we must seek the deeper roots of the much-discussed process

[f]This applies, for example, to the phenomena that belong to the so-called "warm side" of the moral spectrum, such as compassion, loyalty, solidarity, fidelity, trust, gratitude, piety, solicitude, friendship, and love, among others, in contradistinction to the phenomena that belong to the "cold side" such as freedom, equality, justice, and (human) rights, to name a few.

of hardening discernable in social relations. In contrast to the "hard", the "soft" tends to be regarded pityingly as out of touch with the real world. The world, then, is seen, in line with the great unmasking and debunking philosophers, as an unideal world, as a reality to which (so Hume and Kant) every form of normativity, intentionality, and purposiveness are alien, as a world of pure facticity, or, as others will contend, in pursuing this line of reasoning further, that it is characterized by contingency, radical finiteness, and brokenness. Other variations on this theme of the unideal nature of reality are Marx's conception of all thinking and acting as interested and so ideological, or Freud's thesis that all culture with its values and ideals is merely an expression of underlying drives, or the position of Nietzsche, Foucault, and others that human relations are irremediably determined by power, and so on.

Thus, the burden of this critique is always that the ideal dimensions of reality as we experience it, as they have been formulated in an idealized way in classical philosophy, constitute the façade of another reality, markedly less attractive and noble, which is camouflaged by credulity, hypocrisy, or a "false consciousness". Things are thus never what they seem. Behind everything of value lurks something dubious, what not only glitters but seems indeed to be gold turns out, upon further analysis, to be dross. And one cannot escape the impression that this unmasking of the "higher" is conducted with a grim satisfaction.

If things are never what they seem, then what seems to be in a text is never what is "really" there, either. Nor do such readers appear to find it of any real interest, when there is something else to give their attention to, something hidden, perhaps subversive, at any rate certainly different from, and so contrary to, anything like an "obvious meaning". The possibility of mutual understanding becomes highly unlikely, then, if, as a Dutch philosopher has recently expressed it, understanding is based on misunderstanding.[8]

In short, an "anti"-disposition is characteristic for the whole of this manner of philosophizing: it is anti-metaphysical, anti-humanistic, anti-utopian, and so on. And all the proclamations of the end (or death) of religion, morality, art, humanity, history, the great stories, and of philosophy itself, have the same import. To put it yet another way, philosophy is here, to a very great extent, negative philosophy, built round a negative central thesis,[9] criticism devoid of anything deserving of the name constructive.

4. The Flattening Out of the Image of Reality

It will not have escaped the reader that (to put it mildly) I view with very mixed feelings both the comprehensive "reversal of the world" and the particular shift in accent in philosophy from a high to a low style which I have sketched above (in what is obviously a highly schematic, or — to use Max Weber's terminology — "ideal-typical", form). I think that these changes have brought with them that in most contemporary philosophy only a very contracted and truncated version of, or selection from, our experience receives attention, that there are dimensions of this experience which are not, or are at best insufficiently, articulated, that, to put it another way, what we have to do with here is a halved and flattened out image of reality.[10] But that is not all: the situation within philosophy is intimately interrelated with that within society in general. Social problems are always problems with an inner dimension, spiritual problems, as well — that is, problems on the level of how people look at things, at the world and themselves, and how they allow their attitudes, behavior, and way of living to be determined by this. In particular, I think that a number of our current social problems, such as environmental degradation, the increasing levels both of agression and of coldness and hardness in our relations with each other, and the extent to which, for example, modern existence, politics, and policy all betray a lack of vision, are ultimately spiritual problems bound up with the modern lowness of style.

And yet — and that word "yet" indicates how very problematical the situation is — and yet there are good reasons for this shift from high to low style in philosophy, art, and society. The "enchanted" image which classical philosophy had of the world, with its emphases on ideality, positivity, order, meaning, noblesse, and attainable truth, has invited ever more question-marks, and suffered a steady erosion of its credibility. And credibility, plausibility, is in my judgement the decisive criterion for a philosophical train of thought. If I describe philosophy — and it is well-known that there are few questions about which philosophers have such widely differing opinions as that of what philosophy really is — if, then, I nonetheless describe philosophy as the attempt to articulate and account for our experience discursively in as comprehensive a manner as possible (or, to put it slightly differently, if philosophy is the attempt to elaborate the frame of reference that takes the most adequate account possible of the totality of our experience), then what is decisive for the acceptance or rejection of proposed philosophical accounts, is the question of whether we recognize

ourselves in the images of reality and self evoked, or not. And with that last — that being able to recognize ourselves — is said, again, that we are here concerned with a plausibility that is arrived at through a process of consulting with others and with oneself; one can, therefore, call this a reflexive plausibility, in contrast to an object-oriented plausibility that discloses itself in how well it explains something, makes predictions possible, and such like. The history of philosophy can then be understood as the ongoing debate between such accounts, and especially with respect to the seldom more than partially explicated basic premises or presuppositions that underlie these accounts and upon which they are based, a debate in which, as already suggested, the degree of reflexive plausibility an account possesses is finally decisive.

Seen in this light, classical philosophy has become implausible because it has ignored or at least has not taken sufficiently seriously various important aspects of our experience (of, for example, contingency, disharmony, suffering, evil, and the murkiness of reality which continues to confront our attempts to understand and know it). And, further, it has had no eye for the legitimizing function of images of reality and humanity with respect to social conditions and especially their abusive aspects — for the ideological character of such images, in other words. In short, the universe of classical philosophy is a "beschönigtes Universum", one that has been far too prettied up. For this naiveté and blindness, classical philosophy has, since the Enlightenment with its fight against prejudices and idols, been subjected to ever harder criticism. Something which one can understand and with which one can sympathize to a considerable degree, and so, something possessed of considerable reflexive plausibility. It is no wonder, then, that a substantial dose of scepticism and mistrust forms part of the standard equipment of modern human beings and that the ideal is under suspicion from the start.

5. A Critique of a One-dimensional Concept of Experience

Nonetheless, we are beginning, partly (though by no means solely) in response to ominous developments within society, to awaken from our intoxicated anti-ideal dream. Or, to put it another way, the question arises whether the project of unmasking pursued by the Enlightenment has not accomplished a stripping down of our thoughts and experiences so radical as, upon further consideration, to seem equally implausible. And I think that this question must be answered in the affirmative. In support of this

conclusion, I would adduce the following: modern thought is by and large dominated by a sharply reduced concept of experience, namely, that of what is observable from the outside. What is considered "real" here, is what can be reproduced or duplicated at will under conditions prescribed by us, apart from (for example) the more personal circumstances of the experiencing person, and so from his or her outlook and life experience. It is no wonder, we may note parenthetically, that there is no place here for any such thing as wisdom — the very goal of classical philosophy! It is clear that this is the type of experience characteristic of the natural sciences, that has long served as the model for what counts as "real" knowledge.

At the same time, we need not ponder long to come to the conclusion that a whole range of forms of experience are here treated as equivalent to that type or are wrapped up under the rubric of "all things being equal" and so, in principle, are all equally excluded from any real attention to their distinctness and possible importance, forms of experience that we are not only not prepared, but are in fact not able, to give up — not in practice at any rate, theory being in this respect more docile and submissive. One thinks, to embark upon a couple of examples, of the experience of the self, including the way in which we experience our own moods and feelings and frames of mind. (According to behaviorism, the champion of the externally observable in the field of behavioral sciences, you can only judge your own state of mind (cheerful, disappointed, sad, lonely) by studying yourself in the mirror — though in practice nobody believes that.) We might further think, where types of experience which are essentially distinct from the externally observable are concerned, of experiences of understanding of, and mutual understanding with, others. One of the greatest philosophical discoveries of the twentieth century is that of intersubjectivity as a distinct category — that is to say, that the I–thou relationship cannot be adequately discussed in terms of the detached I–it relationship, or of the externally observable which is connected with the latter. Other examples of types of experience which, upon further consideration, we are not prepared to allow to be "equalled" out of the picture, are the aesthetic, the moral, and the spiritual. For instance, the essence of the experience of being deeply moved by a piece of music, a poem, a miniature, or whatever other example may come to mind, will be misunderstood completely, if it is approached in terms of anonymous processes such as sublimated libido. Not that no interesting light may, incidentally, be allowed to fall upon the experience by this manner of approach, but, once again, it completely misses the heart of the matter.

It is worth noting how, from the very quarter which is itself above suspicion, that of the natural sciences, the one-dimensional concept of experience is made the subject of discussion. I am thinking of one of the finest parables of twentieth-century epistemology, that of the ichthyologist, by the English astrophysicist, Sir Arthur Eddington.[11] In this parable, Eddington compares the physicist with an ichthyologist. In the course of conducting his research into marine life, this ichthyologist casts his net, hauls it in again, and examines his catch in his customary way. After examining a number of catches, he discovers a fundamental law of ichthyology, to whit, that all fish are bigger than five centimeters long. He considers this conclusion a fundamental law, because it is confirmed anew by every catch, without exception.

An observer suggests that this fundamental law might just possibly have something to do with the size of the meshes of the net, each of which is five centimeters square.

What Eddington means to say, of course, is, that what we get to see, is to a great extent dependant on our way of looking and on the categorical scheme we thereby employ. That makes things apprehensible, but, at the same time, it can also make things inapprehensible — if they happen not to correspond to the categorical scheme employed. The "metaphysician" considered the precondition which the ichthyologist maintained, that of catchability in his net, as an impermissible, subjective truncation of reality, and right he was. He did not deny that what the ichthyologist "caught" was reality, but he did deny that that was the whole of reality (in this case, all the fish that live in the seas).

Eddington's point is, to indicate the limitation, in principle, of all scientific knowledge. That means that phenomena which are nonexistent for the "nets" in use today, need not be so tomorrow with the use of other models ("paradigms"); in other words, it is possible that there are whole groups of phenomena, or of dimensions of phenomena, that escape notice. Another conclusion is, that different sorts of nets can draw different sorts of phenomena to the surface, without any contradiction being necessarily involved. To put it another way, there are various, very different ways into the "same" reality. Finally, the parable implies that such non-scientific ways into reality as those of everyday experience and practice, of self-experience, and further, of the arts, morality, religion, myth, and mystical experience, regain, in principle, their right to due regard, and so their just place in the scheme of things.

6. The Rehabilitation of Suppressed Forms of Experience

And indeed we see all these conclusions drawn in twentieth-century philosophy. So, existential philosophy thematizes inner experience that is lived through. The rehabilitation of ordinary language against the dominance of scientific language is introduced in the late Wittgenstein, to be set forth in the so-called "ordinary language philosophy". Phenomenology displays a parallel movement, in which the theme of the "life-world" (re)gains a central position. And, to allow one further example to suffice, in Cassirer's monumental work, *The Philosophy of Symbolic Forms*, besides science are also recognized language, myth, religion, history, and art as distinct forms of the constitution of reality. They represent, in other words, irreducible dimensions of the experience of reality. To each of these dimensions corresponds a distinct way of knowing, and so a particular, proper mode of rationality. The idea is, in short, that reality does not allow itself to be unlocked in one single way only, with the help of only one method and manner of knowing, but, instead, only by a multiplicity of ways. Obviously (we may note in passing) the problem then arises of the relations of these various means of access one to another.

Twentieth-century philosophy, one may say, has ushered in a wide-ranging rehabilitation of forms of experience that had been discredited or suppressed by a reductive conception of experience and rationality. This rehabilitation signifies the recognition that the marginalized forms of experience possess their own plausibility, which makes it impossible to continue to disregard them.

This development in twentieth-century philosophy can be seen as a counter-movement with respect to the "reversal of the world" considered above which, among other things, comprised a turn from ideality to anti-ideality. In this sense, then, this development also signifies, in principle, a rehabilitation of the ideal.

In saying this, I certainly do not mean to suggest that we can view this rehabilitation as the distinguishing feature of twentieth-century philosophy. On the contrary, looking back over the past century, I think that one can speak of two lines of development that are opposed to each other and which we may indicate by using the terms radicalization and rehabilitation. Radicalization points to the setting forth of the project of modernity with its accent on criticism and demystification (the end of truth, utopia, the great stories, *etc.*). It is the story of the continuing process of disenchantment, prosaicizing, and pragmatizing[12] — after the ideal ("the spirit") was driven

out of the realm of nature (the reality of the object) by Descartes, Locke, and Kant, among others, this process has repeated itself over the last 150 years with respect to the domain of the subject. This is the philosophy that articulates the way of perceiving things of a society dominated by the STE-complex[13] — the complex of science, technology, and economics — in other words, a society characterized by formalization, instrumentalization, makability, and utility. I do think, however, that this philosophy (which, again, is that of the radicalizing of the project of modernization, with its anti-ideal disposition) is beginning to show signs of exhaustion, with the result that a new perspective can be more easily sought, and with it the well-springs of a new spiritual and social élan.

And, indeed, in my judgement, the awareness continues to grow, in an ever-increasing degree, that this dominant framework of perception has prematurely declared a whole range of things to be obsolete that in the event appear to be things we cannot do without, such as the ideas of truth, objectivity, intuitive knowledge, of the subject or self, of non-conventional values that appeal to that self for recognition, of care or concern for others and (in various senses) the other, and many more. It is in this line that the many rehabilitations that are characteristic of the philosophy of our age lie.[14] These philosophical developments also serve to express a widely felt uneasiness about the ever-increasing, ever wider colonization of sectors of our life by technological and economic rationality. And they provide stimuli to decolonize these sectors again, to allow them to function once more in accordance with their own standards and points of view. Not in the last place is such a decolonization of the university necessary, a liberation of the world of science and scholarship (with respect both to education and research) from the oppressive embrace of factors lying outside science and scholarship proper, such as immediate social utility, attunement to the job market, and organization along bureaucratic or business-managerial lines, to name a few, whereby, as suggested already, alien standards are applied to scientific and scholarly activity, seriously hampering it in its proper functioning.

That the colonializing grip of the STE-complex on our society is a strong one, is clear. If, however, the other philosophical developments noted above are effective, in the sense of revealing that the dominant way of looking at and thinking about things, upon which the prevailing forms of culture and society orient themselves, misrepresents and marginalizes dimensions of experience that we cannot do without, this means, then, that that society and culture are still living by an understanding of reality and rationality

that has meanwhile been exploded.

7. An Organicistic Natural Philosophy

There is yet another consideration that points in the same direction, to which we will here devote a few words, not least because of the especial importance of this part of our train of thought for environmental philosophy. The image that our modern technological pragmatic society has of reality is, as we have already suggested, that of the "mechanistic image of the world", an image of nature as an aggregate of dead, blind, dumb things without any inner dimension, or, again, of a domain of merely passive, reactive entities from which every form of subjectivity, spirit, mind, intentionality, purposiveness, meaning, value, and significance — in short, every form of ideality — has been eliminated.[g] It is superfluous to say that this is the sort of reality that is made to measure for our manipulative intervention.

Here, too, however, the fronts seem to have shifted significantly in the course of the twentieth century, in the direction of a natural philosophy that has come to take a critical distance from the "mechanistic image of the world" and all that that includes. Ever more frequently, the contours of an "organicistic" or ecological cosmology begin to delineate themselves. Therein, as the word "organicistic" already indicates, is the basic form of being of reality not dead, inert matter (back to which everything else — life, consciousness, social existence — is deemed to be traceable and reducible), but energetic structures of which such properties as self-ordering, autopoiesis, and self-referentiality are characteristic. And herewith arises the image of a reality that is inherently dynamic, active, creative, spontaneous, striving. In other words, even on the most elementary levels, natural processes possess — albeit in pianissimo, yet nonetheless possess — characteristics which by way of association we connect with signs of life; one might even speak in terms of the first traces of the character of a self. And the more the degree of organization and complexity of these appearances increases, especially when critical thresholds are crossed and new types of phenomena manifest themselves, the more the appearances are characterized by a sense of creativity and a self.[15]

[g] See, for example, Kant's *Kritik der Urteilskraft* [Critique of Judgement], B 327: "Aber die Möglichkeit einer lebenden Materie (deren Begriff einen Widerspruch enthält, weil Leblosigkeit, inertia, den wesentlichen Charakter derselben ausmacht) lässt sich nicht einmal denken..." ["But the possibility of a living matter (which concept entails a self-contradiction, since lifelessness, inertia, constitutes the essential characteristic of matter) simply does not lend itself to thought..."].

In this open image of the world such things as life, evolution, consciousness, sociality, and meaningfulness, are no accidental exceptions dependant purely on chance, a thin epiphenomenal superstructure, so to speak, of a universe conceived of as mechanistic. They are, on the contrary, phenomena whose disposition is inherent in the structure of reality, the realization of potentialities that repose in "matter" (but then, a very differently conceived matter than that of the mechanistic image of the world). In other words, elements of life, of an inner dimension, of mind and spirit, are present in the foundations of the universe, and, under the proper conditions, manifest themselves ever more clearly. This means that it makes sense to read the "lower" in the light of the "higher", where such features as active reaction to surroundings manifest themselves with increasing clarity, instead of always wanting to trace back, and reduce, the higher to the more elementary, as modern thought has for the most part been inclined to do. Indeed, from the point of view of this natural philosophy, the lower can been seen as the foreshadowing of higher forms of order and integration, and matter can be seen as latent mind and spirit.[16]

At the same time, this rediscovery of the presence of spirit in nature means that it is always a mediated presence. Perhaps the distinction between classical and modern philosophy might be formulated in this way: that classical philosophy thought that spirit and ideality could be thematized in pure culture, that philosophy could fully penetrate and illuminate reality to its very foundations, that even such things as the good and the truth were within its grasp in definitive and unadulterated form. This, because, as we have suggested above, it supposed it could think reality sub specie aeternitatis.

By contrast, modern philosophy has come to appreciate the fact that the ideal exists ever and only in a mediated, embodied form, as a dimension of the material, organic, psychic, social, and cultural reality. Modern thought has indeed become so obsessed by the fact of mediacy, and so by contextuality and historicity, that these considerations threaten to fill the whole picture, eclipsing all else. To put it briefly: for classical philosophy, the only thing that mattered was the message, with respect to which the medium was of no real importance, while in modern thought the message is becoming steadily less distinguishable from its expression. And so modern philosophy has to a very great extent become an analysis of the medium, or of mediating structures, of the form in place of the content — whether one thinks of logic, semiotics, linguistic analysis, or the transcendental-pragmatic approach to normative questions, or for that matter the whole

transcendental philosophical way of thinking.[h] The concern is always for the preconditions or context that are decisive for a given subject, with philosophy limiting itself to a sort of propaedeutic, and never coming to the matter itself (such as metaphysics, the philosophy of history, or normative or other questions radically concerned with content) at all.

The rehabilitations in the philosophy of our era point to the awareness that this is no adequate reaction to such questions. Questions such as how we should understand the reality that surrounds us, what our place in the scheme of things is, what makes life worth living, and so on, do not allow themselves to be suppressed. Philosophy will have to concern itself with the content of such questions. The widespread disinclination to venture to address such questions in contemporary philosophy (and culture) is, so far as I can see, bound up with the anti-ideal disposition of the mainstream of modern thought (and not only philosophical thought), with its marked tendency to a low style.

The criticism modern thinking had for the naive idealism of classical philosophy has in important respects proved just: it has opened our eyes to the phenomenon of mediation, of the remarkable interrelatedness of the ideal and non-ideal. What is now beginning to delineate itself is, that this criticism has produced a constricted and etiolated image of reality and the self, that has, in turn, strongly contributed to the distorted, lopsided development of society in which certain of its sectors enjoy a predominance alarmingly free of check or restraint, the STE-complex to which we have already devoted some attention above.

8. Second Reflection

What we need is, in other words, a new, second reflection to criticize and correct the first. (Some speak in this context of a Second Enlightenment, to resolve the discrepancy between the intention and the outworking of the first. The intention of the Enlightenment, and of philosophy for that matter, was to live on the basis of insight. The discrepancy is apparent from the constricted conception of knowledge and experience.) This metacriticism and correction of the first reflection and its shortcomings must, so far as I can see, comprise a rehabilitation of the ideal, a search for new conjunctions with such fundamental categories of the classical philosophical tradition as

[h] An analogous development is discernable in art (and particularly in the art of painting), whenever the attention shifts from the visual subject to the way in which it is apprehended, as in impressionism.

truth, objectivity, the idea of objective good and of real justice, the recognition of one's being a self, care and concern for others, disinterestedness, and meaning, to name a few.

Not in order simply to return to a premodern way of thinking, to read, once again, the world as the form in which the ideal manifests itself, to think that truth, goodness, the essence of things, and the like, are subject to immediate apprehension, that is, in an unmediated form. But certainly to recognize them as ideas that suffuse our thinking and acting with their light and direct them, and that we therefore constantly affirm performatively and implicitly, even where we explicitly deny them (positions such as those of Nietzsche and Foucault being good examples of continuing to live parasitically upon what one wars against — something of which both were admittedly aware).

But with such a transcendental-pragmatic or apagogic-indirect plea, as it is called, the work is still only half-done. In this abstract form, the argumentation is at best intellectually compelling, without having that force which can move someone to adopt a certain attitude towards life, that can be expected of a philosophical train of thought. To hope to accomplish that, a detailed account of the way things are, is called for as a complement, one in which "experience", and our experiences, are set out and articulated in as comprehensive a way as is possible, and particularly with respect to those dimensions which are marginalized or forced out of the picture in the now dominant frame of reference. In part, we should be able to do this in continuity with the classical range of thought (including, for example, not only Aristotelian and Stoic but variously non-western thinking, as well). In part, we will also have to blaze new trails, among other things in connection with developments in the sciences.

I think that in today's world, devoid of vision as it is, philosophy must put aside its paralyzing fear of speculation and take the risk of daring to broach metaphysical subjects, and to venture upon interpretations of existence, and representations of what might constitute a life well-lived or a good society,[i] in short, upon thinking in a high style. That one can no

[i]This is, among other things, to say that neither politics nor policy can do without "ideologies" (that is, those visions of society that inspire and guide our actions). In other words, in order to act effectively to solve problems we need the guidance which such things as a framework instinct with meaning, as ideal images, and as "utopian" models, give. (With respect to a renewed attention to the importance of ideals, see W. van der Berg and F. W. A. Brom (Eds.), *Over Idealen. Het Belang van Idealen in Recht, Moraal en Politiek [Concerning Ideals. The Importance of Ideals in Law, Ethics, and*

longer be so unencumbered in the working out of such representations and accounts as was possible in classical philosophy, should be obvious from all that has been said above — just as we are precluded from recapturing in poetry the high style of the Baroque, or even of the fin de siècle, so much nearer us in time, and yet so unreachably distant, now. But it is to be hoped that we may regard the anti-ideal iconoclastic tempest of modern times as having gradually blown itself out, and that we can embark upon the constructive work facing us with renewed confidence, and so give the long-stifled dimensions of experience their due once more.

Let me, just for the sake of clarity, underscore the fact that I am pleading here, not for wild, undisciplined speculation, but for the sort of speculation that is well-grounded, and always ready to give an account of itself. And since we know that all theory has a meaning surplus to direct experience, and so, that all theory is in this sense speculative — without being discredited by that fact alone, surely it does not behove philosophy to be purer than pure in this respect. Furthermore, everyone adopts at the least an implicitly metaphysical position, for example by not taking certain matters seriously. If it belongs to the very humanity of human beings to want to live by light (which is, once again, the fundamental idea of philosophy), then that in itself asks that such an implicit metaphysical position be made more explicit. That is, moreover, the only medicine against that social development that thinks ever more exclusively in terms of functional rationality, because its eye for ends and goals is becoming more and more blurred, and visions that make orientation possible, an ever scarcer commodity.

If the fundamental idea of philosophy is indeed to want to live by light, this can only be properly pursued if our interpretations of reality and our place therein are spelled out in as fully articulated a way as is possible. Only in this way can such depictions and accounts speak to people, especially on an emotional level, and so be in a position to invite, to stimulate, and to mobilize in the direction of accordant attitudes and styles of living. Philosophy, understood in this way — also when it is pursued in the form of metaphysics, anthropology, or social philosophy — is at least implicitly practical, and so an implicit ethics, while ethics is rootless if not exercised in combination with metaphysics, anthropology, and epistemology. In short, ethics cannot see to act properly without metaphysics, even as metaphysics

Politics] Deventer: Tjeenk Willink (1998) — and, for a revaluation of the utopian genre, M. de Geus, *Ecological Utopias. Envisioning the Sustainable Society.* International Books, Utrecht (1999).)

is ineffectual without ethical implications or effulgence.

Philosophical accounts, as already suggested, are finally judged on the basis of whether or not they offer a recognizable and believable interpretation of the whole of our experience — on their reflexive plausibility, thus. I am persuaded that a broad stream of modern low-style thinking, that has no real place for ideals, spiritual values, and such phenomena as attention to, and care for, our fellow human beings and other fellow creatures, cannot pass this test of plausibility. Hence my plea for a resumption of a (suitably muted) form of high-style thinking in philosophy.

It may be, it is even probable, that such considerations of plausibility will not lead to identical conclusions, at least not in the short term. That, too, is a well-known phenomenon, that changes of direction in thinking have their time of incubation. In such circumstances, I can only react as the Friesian king Radboud did (if I may be permitted to conclude with a story from my native land, Friesland). When he was about to let himself be baptized a Christian, he asked, at the very last moment — he had one foot already in the baptismal pool — if his conversion to Christianity would mean a separation from his ancestors, who, after all, had died as non-Christians. When this question was answered in the affirmative, he drew his foot back out of the baptismal waters again. He did not want to sever his relationship with those to whom he felt himself united.

If, then, declaring oneself in favor of a certain type of philosophy should already be such a question of existential choice, then I feel myself most at home in the company of those, whosoever they be, who believe in the ennobling working of philosophy, spirituality, art, and culture. Granted, that is a belief, but one that I am persuaded is not without its reasons. To anyone who thinks otherwise, I can only say, paraphrasing Lessing, "Let us go home, each with his own ring"[17] — that is, his own conception of philosophy. And let us leave the power of the stone in our rings to do its work. Let us only hope, that we need not wait a thousand years, as was the case in Lessing's parable.

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17. G. Lessing, *Nathan der Weise [Nathan the Wise]*, act III, scene 7.

TOWARDS A RE-DELINEATION OF THE HUMAN SELF-UNDERSTANDING WITHIN THE WESTERN WORLDVIEW: ITS SOCIAL AND ETHICAL IMPLICATIONS

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This article focuses on the relation between worldviews, sciences and us. Its point of departure is the significant mutual influence of the Western worldview and sciences. It shows how the intertwined construction of science and worldview has modelled our conceptual self-understanding, our being and our acting. The issue is considered from a philosophical-anthropological stance, with due attention being given to past delineations and future alternatives. It is argued that, within the framework of the Western worldview, self-realisation is considered essential for being a human self. There is a tacit, yet conscious, agreement that the way to attain self-realisation is through the gradual development of two potentials: the rational potential and the potential for self-expression. The authors recognise that both are indispensable in forming the human self, but point out that the nature of the development of these potentials can conceptually be misinterpreted, causing problems on the individual, societal and ecological levels. In order to prevent the development of the rational potential and the potential for self-expression from receiving undue emphasis, two more potentials are introduced on the conceptual level, to wit the ethical potential and the potential to be situated in and oriented towards a larger and meaningful whole. The assumption is that bringing these to the fore will also affect the very definition of self-realisation.

Keywords: conceptual self-understanding, rational potential, potential for self-expression, ethical potential, the potential to be situated in and oriented towards a larger meaningful whole, "le différend"

1. Introduction

In the Western views of the world and of the human self, it is a common idea that people — all alike — should be enabled to develop themselves gradually and constantly throughout the course of their lives. This self-realisation is implicitly thought to become feasible through the development of two potentialities: the intellectual potential and the potential for self-expression. Society is structured in such a way as to maximise the development of its members. People are stimulated to study life-long and many facilities are set up to foster the potentiality for self-expression.[1] The implicit driving principles behind this are two-fold: the principle of freedom (every member of society enjoys an equal basic freedom to determine their own lives) and the difference principle (every member of society can rely on an equal distribution of means, except insofar as inequality improves the situation of the poorest).[2]

Although in the Western worldview the emphasis is on these two capacities for self-realisation, we argue that it is highly desirable to acknowledge the ethical potential and the potential to be situated as essential for self-realisation. Firstly, we think that, implicitly, people already act as if these latter potentialities are important to them. Secondly, in daily reality there is an interference of the different potentialities, in the sense that strong expression of one potentiality may hamper the development of another. This is precisely what seems to be the problem with today's Western worldview, which is having a far-reaching impact on the social fabric. To the authors the outspoken actualisation of the intellectual potential and capacity for self-expression as opposed to that of the two introduced in this article, seems to be at the heart of such individual and societal problems as alienation, unbridled individual autonomy, and the fragmentation or moral disintegration of society.

The idea that one expression may hamper the development of another is akin to Lyotard's notion of "le différend". In Lyotard, a "différend" is a conflict between two or more parties in which one of them cannot be a legitimate judge because of the absence of a rule that may be applied to all parties' argumentations. The fact that one position is considered legitimate should not automatically imply that the other positions are not.[3,4] Hence,

"un différend" is a dispute which cannot be settled since the rules available deny the position of at least one of the committed parties. It does them wrong ("tort"). Like Lyotard, we take it that structuring will invariably produce "différends". These "différends" are the negation of the existing order, and hence provide its borderlines.

Lyotard states that it is the philosopher's duty to "témoigner du différend", *i.e.* to make this discrepancy explicit. Philosophy needs to ensure that "the other" be heard. This should not be seen as a process of legitimation, because this would only create a new, all-embracing viewpoint negating or oppressing otherness. Lyotard seeks to develop alternative viewpoints which tackle the self-evident in order to make visible that which the self-evident conceals. This is a different approach from the more common one of falsifying existing discourses and practices within a certain (scientific) field.

This paper takes a similar course. Next to the existing potentialities, which are firmly established within modernity, we wish to bring to the fore the excluded potentialities, as well as its "natural" process of exclusion. Our basic assumptions both overlap and differ from those of Lyotard's. The following three points will clarify our position.

1. As we mentioned above, according to Lyotard, any conceptual ordering will create "différends". We agree that these "différends" have their own logic which cannot become clearly visible within the prevailing discourse. However, we do not perceive an ontological incommensurability between these different logics. Commensurability is possible by creating a conceptual meta-perspective in which both the prevailing or hegemonic and the different have a place of their own.[a] We intend to reach that goal by thinking in terms of potentials. In conceiving the two most important emancipatory pillars of society — the aptitude for rationality and self-expression — as potentials, it can be made apparent that the incommensurability with other logics is at the level of articulation or actualisation.

The ethical potential and the potential to be situated in a larger meaningful whole are "le différend". As we will make clear later in this paper, the ethical potential has been wrapped up in the rational potential of man, so that this potential has been reduced altogether to a specific rational discourse. The other mainstay of ethics, the "pre-rational being-touched-

[a]Since we are part of that very worldview, we do not think an objective outsider perspective is possible; this, however, does not prevent us from taking on some meta-perspectives.

experience", cannot thoroughly be understood from within the rational logic. Moreover, this discourse does not seem to allow for conceiving ethics as a potential in itself, which is primordial for self-realisation. The same shortcoming is even more manifest in the case of the potential for being situated in a larger meaningful whole, which, within the Enlightenment articulation, has for a long time been classified as being synonymous with conservative tradition or religion, and even as restricting personal freedom. This logic has hampered people's ability to approach this central aspect in its non-articulated potential state, or to perceive its essential significance for human selves. The state, in staying "neutral" as to personal choices, has not fostered opportunities to develop this potential in diverse ways in the way it has for the rational potential and the potential for self-expression. It is our very strong conviction that, like the rational potential and their potential for self-expression, people, to become human selves, also need to be able to develop the two excluded potentials referred to above.

2. As a second point, we want to clarify our position on human autonomy or self-determination. If we are to believe Habermas, postmodernists should be labelled "neoconservatives".[5] Habermas draws this conclusion on the basis of the following. Lyotard, as a postmodernist, is following the footprint first made by the Frankfurter Schule, of which Adorno and Horkheimer are prime exponents. Having experienced Nazism, they state that the instrument of emancipation — humans' own autonomy and rationality — is, in fact, at the same time the instrument of their destruction. They pessimistically conclude that once people take their fate in their own hands, it can only go wrong. From this perspective, the discourse of makeability and controllability of man, society and nature becomes pure illusion.[6]

Lyotard takes up a similar discourse. While Adorno and Horkheimer declare the emancipatory Enlightenment to be totalitarian due to its own rationality, Lyotard situates the totalitarian aspect in language itself. For Habermas, their positions make it impossible to acknowledge the modern claim to self-determination, hence his label of "neoconservatives". Contrary to postmodernists, his aim is to rescue the modernist project by stating that modernity is not dead but unfinished.[7] According to Habermas, there is still an unused rationality potential with which to complete this modernity project, and which the postmodernists failed to see.

We do not aim to prove Habermas right or wrong; we just want to make clear our position within this discussion. From a cultural-anthropological perspective, we share the idea that the principle of human

self-determination should not be open to discussion. However, by no means does this imply that we will automatically agree with all of its possible interpretations. In fact, we do not, as this article will make clear. Also, this principle does not cause us to adopt a universalistic, one-truth stance, although we neither opt for the other end of the scale, *i.e.* a relativist standpoint fostering indifference. Rather, we are inclined to subscribe to pluralism within a certain frame of reference. It is from within this context that our next point should be understood.

3. The third point reflects our position on the universality of research results — to which Lyotard is very much opposed. It may seem that we claim some universalistic truths, and to be fair, we do. In the tripartite postulate described above, we firstly perceive human selves as potentials to be developed, we secondly claim that the Western worldview is characterised by the implicit recognition of only two potentials as important to self-realisation, and we thirdly declare that the development of the ethical potential and the potential to be situated in a larger whole is "le différend". This postulate introduces a universalistic flavour because it assumes that the development of these four potentialities — and not just the first two — is indispensable for humans to unfold their selves. Our viewpoint is that the four potentialities as bare, *empty* concepts, that is, in their state as potentialities, are nothing less than the *underlying* fundaments of self-realisation. Their *articulation* varies from one (sub)culture to another, but they are nevertheless articulated. The *degree* of their articulation also varies from one (sub)culture to another. There are cultures in which the different articulations of the potentials are not readily commensurable.

Acknowledging the need for further research to prove this hypothesis, the authors wish to relativise the supposed universality of their statements. They are aware that, at some later stage, other potentials that are currently excluded may be conceptually visualised as even more important, decreasing in importance those described above. According to the authors, such an evolution reflects the very essence of investigation: on the one hand, researchers believe in the universality and importance of their work and goals — making sound involvement possible —, and on the other, they are aware of and accept the fleeting character of their insights — which may well be exclusive themselves.

This paper elaborates the four potentials. The first part deals with the first two, the way they came into mental existence, their articulation and actualisation. The second part intends to provide handles for dealing with the ethical capacity, and the capacity for situating oneself in a larger

whole. Before that, we will shortly define what we mean by potentiality, articulation and actualisation.

By *potentiality* we mean, as did Aristotle,[8] something existing as a possibility, something which is capable of turning into actuality under favourable conditions. Potentiality is the power to be, without yet actually being. It is different from being but also from non-being. Potentiality cannot be envisaged in itself. It can only be represented by way of a certain articulation. Although potentiality in itself "is", it needs to be recognised by humans as such in order to be.

Articulation is the mental conversion of that potentiality into meanings, ideas, intentions and discourses. The precipitation into a mental form makes it difficult, and sometimes impossible, to visualise yet another form. In society, different articulations co-exist. However, society as a whole is led by a more or less uniform bundle of articulations which are expressed as ideals, goals and orientations. Moreover, although articulation is inherently a reduction of potentiality, people cannot express potentiality but through its articulation. Expressing a potentiality is making it tangible, bringing it into consciousness and into existence. So articulating a potentiality is also reducing it; yet at the same time it is a creational act.

By *actualisation* we mean the (further) formation of this potentiality into materialised forms such as structures, artefacts or other embodiments. Actualisation has a connotation with static. Yet, because materialisation is the result of human endeavour, even manifested actualisations, seen over time, are dynamic processes, ready for change, for rise and fall, and for co-existence.

2. The Modern Perception of the Human Self

Prior to different ways of expressing and implementing potentialities, there is the deep level of believes we live with, a view of the human self and the world which we consider ontologically true and non-discussable. It is on this meta-level of worldviews that the human potentials have — implicitly — been recognised as such. At this level, too, changes occur over long periods of times. The current times in fact seem to present such changes, leaving society with different and fragmented meanings of reality existing side by side.[9] Yet, the fact that human beings have an intellectual capacity and a capacity for self-expression has not been subject to change or challenge; only the way in which these capacities have developed has been open to criticism.

In the Western worldview, the development of the rational potential and the potential for self-expression have not always been judged as core building blocks for self-realisation; indeed, for ages, self-expression was not regarded as a potentiality altogether. Self-expression came into its full bloom only as a reaction to the particular development of the rational potential. In what follows we will try to show how these potentials came into being conceptually and how they have been articulated through time. We will first describe this process in neutral terms, and then show that somehow this articulation went "off track" by pointing to the negative consequences on a conceptual level. As we have said, we believe that these rather eccentric articulations are due to the conceptual ignorance of the fundamental worth that the ethical potentiality and the potentiality for being situated in a larger meaningful whole, have for self-realisation. As long as we are insufficiently aware of their existence, they cannot explicitly serve their function as conceptual beacons.

2.1. *Potentialities Perceived in Modernity*

The awareness and importance of the intellectual capacity and the capacity for self-expression have implicitly been acknowledged as basic principles within the tradition of the Enlightenment and Sciences. The historical move to radical reflection has been essential for both potentials. Moreover, self-expression as a potential is based on a deep belief in human dignity — precisely because of the human reflective ability — and the belief that people need to explore the depth of their inner selves.

In sketching these potentials — without pretending to be exhaustive —, we will draw extensively on Charles Taylor, who provides an in-depth and greatly balanced discussion of their crystallisations through time, although with another goal than ours.[10]

As Taylor makes clear, reason has been an acknowledged capacity for ages. What has changed over time is the perception of rationality, the content of rationality on a meta level so to speak. Starting in Ancient Greece, we can see that, according to Plato, to be rational, not the mind (as a thinking agent) but the soul needed to be orientated in the right direction. In these pre-modern times one had to become touched by the love of the Ideas to be able to understand the surrounding things as they ontologically "were": as participating in the Ideas which gave them being. Hence, knowing the truth was a matter of conversion. Seeing and understanding the right order in turn was seeing the "Good", and associated with attaining

one's "true nature".

In the Middle Ages, Augustin's writings convincingly and emphatically made the point that God's ordering principles are not only outside, but also deep inside the human self. Augustin argued that God is in the intimacy of our souls. To really understand His order, people have to attain self-knowledge through intelligence. But, since people are sinful, they equally need to be healed from sin through intelligence and willpower. Self-knowledge and healing will eventually result in contact with perfection. This perfection is our own (hence the need to love our souls), as well as part of the higher good. According to Augustin, by going down inside ourselves, we also go up towards perfection. Augustin's approach redefined the rational potentiality *within us*, and in doing so he paved the way for a self-expressing potential inside us to be recognised. Augustin himself said: "If by 'abyss' we understand a great depth, is not man's heart an abyss? (...) Do not you believe that there is in man a deep so profound as to be hidden even from him in whom it is?"[11]

However, Augustin was already aware of the potential danger of this inward turn. He described as "evil" the situation in which rational reflection is locked into itself, when humans make themselves the centre of the world whilst dominating and possessing the outer environment. In such a situation, healing is when this self-centredness is broken up, dependence on God is acknowledged.

This "healing" line of thought is interesting, and we will elaborate on it in a while, relating this breaking up of self-centredness not with God, which is also a possibility, but with a reinvigoration of the two other human potentialities referred to above.

Descartes made Augustin's reflective stance and inwardness fundamental whilst further developing ideas about the nature of rationality. Descartes argued that for a true appreciation of our own being as immaterial (our real selves) as well as a reality outside us, we have to leave behind the false road of conceiving the world ontologically as self-revealing. We have to understand that there is an ontological split between our immaterial souls and a materialised world outside, of which our body is a part. This materialised world is devoid of any spiritual core or meaningful element. If we manage to grasp this ontological disposition of reality, we will experience the "innerwordly liberation" of the soul.[b] Recognition of the fissure enables us to disengage from the materialised world, and free ourselves from it. We

[b]Ref. 10, p. 146.

will furthermore be allowed a greater understanding of reality the moment we realise that, to achieve true insight, we must not turn outside but inside. Order and hierarchy need to be constructed by humans, who have the reflective ability to do so.

Of course, Descartes did not stand alone in tracing these new lines of thinking. He was rather a part of a tradition of "Modern" scientists such as Bacon, Kepler, Galileo, Boyle, Newton and many others, who stressed the prevalence of matter, and the mathematical and mechanical nature of the underlying ontological "being" of reality, thus giving form to a "rational" worldview.[12] This view gradually enabled the disenchantment of the world. From within this scientific frame, the leading element in people's lives no longer ought to be the senses (in the service of the super sensible Platonian soul) but reason. More and more, the hegemony of reason was regarded as that which offers humans the greatest satisfaction. From this moment on in history, we can notice the progressive reduction of rationality to the realm of "tangible" reality: that which is visible and can be explained in evolutionary, mechanical terms.

In Platonian times, the world order embodied the Good, which we cannot but love. Now that rational control has taken over as the primarily prevailing good, and the world is considered mere disenchanted material, meaningfulness has been reduced — or turned toward — man's sense of his own dignity as a rational being and the articulations sprouted from reason. One major consequence can be an increasing awareness of the self as a substantial self, a self that has a sense of worth *in its own eyes* and optimistically thinks of itself as a *causa sui*, the master of its own history.[c]

Although this line of optimism has rightly met with great opposition, the belief in progress through science and technology is still very powerful, albeit on a more modest scale. To some, including Weber, our condition is no longer open to questioning.

Locke, being a Reformist, implicitly encouraged the development of two more important ontological branches within the potential of rationality, namely the importance of preservation and hedonism. Within the religious framework, Locke made his point convincingly by arguing that, since people have an instinctive urge to self-preservation, it must have been intended by God. Reformists at that time believed that they were called by God to perform a particular line of work, which imparted to their work a higher significance. As a consequence, it was supposed that people could serve God

[c]Ref. 10, part II.

by working energetically (with efficiency and industry) and intelligently (towards the good of all). The combination of self-preservation and industry on the one hand, and the pursuit of a better personal situation on the other, is still a leading economical concept nowadays.

Locke and others also gave a significant impulse for hedonism to be accepted. In doing so, they tended to the seeds sowed by Renaissance philosophers such as Erasmus and More. In Locke's eyes, God not only creates a world for our preservation, a world we can know through reason; He also invites us to enjoy this world. As a consequence, in principle, our intrinsic desire for pleasure is good (not withstanding our intrinsic tendency towards irrationality and evil). Kant added another seed for the acceptance of pleasure, upholding that the experience of beauty could lead to the experience of disinterest. And as Bacon said: in order not to be led away from God, people ought to take on an instrumental stance towards the things of creation. It would protect them against seeing these things as ends in themselves.[d] While Locke built on the hedonist branch of self-expression, Bacon created a spiritual meaning for instrumentality. Because of the persuasive power of their rationale, both stances have since been brought within the "normal" and hence, within the "accepted".

Arguments to enjoy life were subsequently worked out further by early utilitarianists, such as Hutcheson, as was the importance of the relief of pain. There was a strong and optimistic belief that self-love and social behaviour were one, that people would be freed from egoism and pursue the universal good if they rationally understood the importance of freeing the human race from suffering and enjoy life. Pleasure was still implicitly restricted because of its embeddedness in a social and moral context. At the same time, however, in France, a rational legitimisation was provided for another branch of hedonism, according to which man, in order to achieve the ultimate liberation, should forget about all social and moral standards. Although this legitimisation was contrary to what people usually intuitively felt to be correct, it has nevertheless had numerous followers up to our century, in which this kind of freedom is usually regarded as the most important value in life.

In the same period yet another mental branch developed: the importance of self-reliance. Self-reliance was given a strong impulse through the writings of Emerson and it is still very strongly present in the American self-understanding and a major driving force.[13] It is a common idea to-

[d]Ref. 10, part III.

day that, although people are called by God, it is very rational to rely on oneself, and working hard is one way of doing that.[14]

As Taylor describes in great detail, self-expression found its fullest "meta-articulation" in the Romantic period, in which inwardness was further combined with inner depth, and with originality. And although this potential developed in reaction to the atomistically fragmented, instrumental and detached way in which the rational potential was scientifically articulated, materialism and science also played a particular role in this development.

Materialism challenged the Cartesian idea that the physical world was but inert material. It replaced God as the first mover by nature as a locus of force. All beings were perceived as tending to maintain themselves in their being. Furthermore, a growing awareness of geological time started to dawn, in which the immensity of time became clear. Nature thus became a locus of depth, an intrinsic source moving people and rousing their respect.

Rousseau added the language of man's "inner voice" deriving from nature. In contrast to the utilitarians, he made a distinction between different types of needs. To find the "good", the source of unity and wholeness, or again, to become entirely oneself, he said, was to live in agreement with this voice. The good was *defined* by this voice in nature, which we needed to *discover*.

The early articulation of this radical view by Rousseau, who, according to Taylor, never took this far-reaching step himself, further developed towards the deeper inwardness and radical autonomy as we live it today. The pursuit of becoming more and more in concordance with ourselves is considered to lead to the fulfilment of our everyday desires in a rich, complete and significant manner that responds to the natural stream of life. To manifest our sentiments, that which is hidden deep inside us, has now come to occupy a central place in our lives. Articulating means defining what is to be realised. The path for verbalisation is within. There is no sense in pursuing external models, or pre-defined formulations. Not hegemony but autonomy is important, in the sense that man now turns to his inner self for inspiration, primarily seeking contact with his own life-stream.[e]

Hence, humans are currently visualised as expressing *a potential*, as having an inner space full of possibilities, a deepness which makes up their own, full authenticity. It is a richness they will never be able to fully know or express. The articulation of their own originality and authenticity is

[e]Ref. 10, part IV.

nonetheless what is supposed to lead today's free, self-determining people in shaping their lives meaningfully. They represent the ultimate emergence of self-conscious beings having a value in themselves, a value that cannot be questioned. The inner self is the only source of meaning and all meaningfulness flows back to it.

2.2. *Some Worrisome Developments*

Rationality and self-expression have rightly become recognised as capacities. Throughout the ages, in the West, they have been reflected in specific conceptual maps for self-orientation. It has led humanity up a variety of positive roads, such as fundamental reflections on the awareness of human dignity and self-realisation, and the concern for all humanity. Sciences have very much contributed to this goal. The development of the two potentials that are mentioned before, has greatly helped people to reconsider their own lives and venture on new paths.[15] There are, however, also some worrisome conceptual evolutions, resulting in problematic situations on the individual, societal and ecological levels. Although these types of evolution are very much interlaced, we choose to make the following threefold distinction. Firstly, the combination of some discourses on freedom of choice may unwillingly produce a logic that calls on people to realise themselves first. Secondly, different ideas on the nature of rational thinking — such as disenchantment and economic thinking — may lead to an egocentric and instrumental logic. Both developments can take place because of a third troubling assumption, *i.e.* the idea that all meaning comes from within the human self.

It is our firm belief that the expansion of these disturbing evolutions, considered on a deeper level, is due to what we have earlier described as the existence of "différends". The rationality potential and the capacity for self-expression have precipitated, merging into a more or less uniform set of articulations of meanings that leave no mental space for the ethical potential and the potential to be situated in a larger meaningful whole as broad *founding potentials.* Also, within these precipitated articulations, the meanings of certain concepts that refer to these unacknowledged potentials have come to be twisted or misunderstood to the extent that they now require unveiling. The specific nature of these articulations makes it difficult to perceive other precipitations, turning them into "différends". We will now discuss these two points, retaking and elaborating some of the earlier material.

2.2.1. *The right to self-realisation*

In the Enlightenment view, rationality and self-expression are rated highest on a conceptual level. Perceived from an individualistic perspective, it seems our primary right, indeed, our *duty* to realise ourselves. It is the role of the state to take care of the well-being of *all* its members. The state should provide the opportunities for people to develop these potentialities, and people should make use of them. Of course, people are free to assume responsibilities with regard to others, but they are made to believe that this is not indispensable for self-realisation. The generally resulting view of the human self facilitates a choice of "*oneself first*". A conceptual hierarchy has been created in which self-expression and the rational potential are perceived as primary goals to be reached in order to consider oneself a human self. As we will make clear, this view of life entails the danger that we become rationally egocentric, and that, moreover, we may tend to perceive our fellow-citizens from a negative judging framework.

The deeply rooted conviction that this specific self-realisation is up to ourselves is strongly supported by a series of ideas, which we have grouped into two overall parts. The first of these is subdivided into four points, but can be summarised as the importance of the freedom to determine one's own choice. The very fact, however, that in (political) philosophy these ideas on self-realisation have been so strongly ramified seems to prove the importance Western thinkers attach to it. We heavily lean on Kymlicka's overview in shortly citing them here.

1. One main discourse is known as *utilitarianism*. Its major underpinning idea is that experiencing pleasure is the key positive thing people can strive for. What that pleasure consists of cannot be valued. All choices are equally rational; there are no criteria to measure whether something is good or not. Therefore, all different experiences need to be promoted. Yet, the state needs to provide opportunities for people to inform them well about the possible advantages and disadvantages of choices. Progress is conceived as the maximisation of the preferences of *all* people concerned. Consequentialism — a branch of utilitarianism — distinguishes choices according to whether or not they have an effect on others, *i.e.* moral versus personal choices. An example of the latter is personal taste.

A very similar idea is that of *self-determination*. Self-determination assumes that we all pursue a "good" life. A significant number of philosophers agree that people's interests are best served if they can decide for them-

selves what kind of life to lead.[f] They equally argue that people cannot be wrong in choosing. Choosing is seen as a serious matter. Choices express our subjective likes and dislikes. In each case, some things are essential and others are trivial. People are supposed to take these differences seriously, even if they do not always know what this means. Self-determination means having the possibility to deliberate over — sometimes difficult — choices.

A libertarian discourse influencing our self-conception suggests that not pleasure, but *freedom* is the highest good. In claiming that freedom is intrinsically valuable, it is suggested that the more we pursue our choices, the freer we are and hence, the more valuable our lives become. It implies that the guiding principle of our acts is freedom, not the value residing in the action itself. Freedom is conceptually unlinked from the good that people strive to reach *by means of* freedom, such as dignity, material freedom, autonomy, well-being.

The strong belief that *individuals have rights that cannot be sacrificed to other people's well-being* is another powerful idea that has proved conducive to choosing for one's own interests first. Rawls argues that people who are born with a disadvantage have the right to make a claim onto more gifted people. Nozick refutes this argument, asserting that talents are the property of an individual. No other individual can claim any right to the fruits of this talent since in doing so this individual would be claiming a right to part of that very individual. Conceptually, the possibility to claim does not fit in with the idea of self-ownership.

2. Another reason why the idea of realising oneself can conceptually merge with the meaning of egocentrism is the implicitness of liberal core values. According to Kymlicka, for their theory to work, liberals presuppose a natural sociability. The pursuit of freedom sprouts from the belief that humans are social animals using their freedom to achieve common goals. Hence, liberals implicitly perceive a social life as the highest goal, and as a *sine qua non* for developing a sense of morality and rationality.

Kymlicka in his book rightly wants to stress the utmost importance of these tacit postulates. As he says, their implicitness makes the theory weak. Whereas the assumptions about individual rights and personal freedom are clearly expressed, the underlying assumption is not, allowing room for a conceptual slip into egocentrism. A person may now conceive of himself as disembedded.[17] Freedom — in liberal political philosophy envisaged as

[f] Kymlicka mentions the Utilitarists, the Liberals, the Libertarians and the Kantian Marxists, which he opposes to the Communitarianists.[16]

minimal interference with the personal lives of individuals by the state and the church — can now become visualised as freedom from all bonds. Or *vice versa*, all bonds can be perceived as interference with one's personal life.

This line of thought has been elaborated by the Belgian sociologist Elchardus, who introduces the concept of "ethics of limitlessness". Elchardus makes clear that people perceiving the world from within this frame of reference, picture freedom as the possibility to abolish all institutional and social limits, even solidarity with the community. To them, relationships are only interesting in relation to their self-realisation, in which people are considered to play an instrumental role.[18]

The series of thoughts listed above and the implicitness of liberal core values have the secondary effect of providing individuals with a *negative judging framework* with regard to fellow citizens. From within this fused framework, the meaning of the theory of equality can be turned upside down. In origin, this theory states that people can only be held responsible for the choices they make if these occur under fair conditions. To make for a fair initial situation, the state is entitled to help out financially the less fortunate. However, from within a frame of reference in which the primary obligation is to realise oneself, — also economically — this state intervention can be given a different weight. People receiving state support may then be conceived as putative cheats, feigning their situation out of laziness. If a person fails in life, this may be explained from his or her not having worked hard enough, since a less favourable situation is considered to derive from one's own "choice". Rather than being entitled to support, that person should be blamed for failing. Due to the possibility of such stigmatisation, the less fortunate may feel ashamed and refrain from revealing their situation. As Kymlicka indicates, perceiving these people as abusers will lead to erosion instead of fortification of solidarity and mutual concern between citizens.[g]

2.2.2. *The merging of "rational thinking" with egocentrism and instrumentality*

A second worrisome conceptual evolution is the one in which thinking rationally becomes synonymous — merges — with egocentrism and instrumentality. The way we are supposed to think and act in order to be categorised

[g]Ref. 16, p. 88.

within the norm of the rationally accepted is very subtly demarcated in all cultures. In Western culture, at least three main pillars can be distinguished. Firstly, to be rational is to acknowledge that self-determination is a high "good". We commented on this topic in the previous point. Secondly, in order to determine one's own life — and getting to fully know it — one needs to understand that the world is disenchanted. Thirdly, to think and act rationally is to see oneself as a "*homo economicus*", as a responsible, self-reliant and saving adult.

Although not negative *per se*, these three pillars may unintentionally encourage the development of a conceptual image of the self as concerned with self-interest *first*. It may thus become natural to perceive the social and natural environments as instruments to be used on the journey of one's self-realisation.

a. Disenchantment

As we have seen, a profound and long-lasting change within the development of the rationality potential was the way that people came to look upon their relation with external reality, which conceptually shifted from enchantment to *disenchantment* through the elimination of magic and religion. Two goals were aimed at with that shift: progress in the form of freedom for humankind, and an appropriate epistemology for knowing the world, in order to further support progress.

As said before, the freedom to choose is a powerful striving in Western culture. Differently stated, it is the freedom to consciously determine one's own life. To be able to do so, humankind needed to shed two fundamental determinants of their lives: magic and religion. Magic, in the form of influence of environmental forces and ancestors, or *vice versa* as a way to influence destiny, was deeply embedded in rational thinking. It took scientists ages to conceptually relegate this complex ramified concept to the margins of Western thinking and lock it up in the cage of irrationally labelled concepts. Many scientists took their share in this, re-labelling the concept. For example, in the 19^{th} century, Tylor was one of several anthropological scientists who studied other cultures with the indirect aim to rid Western culture of any Christian and Celtic magic related perceptions, labelling such practices as "superstition".[19] Long before him, Locke already had taken some first steps to reverse the psychological dependency on the earth, which was still very strong in his days. He introduced a conceptual twist, stating that it was not the earth that took care of man — and had power over man — but man who took care of himself through his own effort by working the land. To make his point clear, Locke compared the Euro-

peans' wealth with the Indians' poverty, in a subtle way also highlighting the supposed superiority of the Western race.[20]

So to come back to our statement, what we see happening here is that due to an elimination of the ramified concept of "magic" a shift in the conceptual significance of the earth took place. The earth was stripped of her forces, and in that sense reduced to something material. Conceptually, in our worldview, the earth has moved down from a position in which it was considered equal to human (visualised and spoken of in terms of a power, of nurturing and caring being) to a merely materialist level (regarded as an object). It is this very conceptual shift that has paved the way for the logic of instrumentality — an evolution which no doubt is one of the main roots of today's ecological problems.

However, the bizarre thing is that on the level of *experience* we still feel nature to be "living", something which can "touch" us, something that can "give" us energy. Here we can see a clear discrepancy between our human experience and the conceptual detached stance we have learned to adopt as correct from a rational point of view.[21]

In determining one's own life, not only magic, but also religion — God — is a difficult "concept" to work around. As is well known, scientific findings, in particular Darwin's , brought about a mental revolution seemingly leaving no more place for the existence of God. From then on in the Western world, a debate has been going on about whether or not it may be considered rational to believe in the existence of God. Scientists do not agree on what it precisely means to think rationally on this subject. While some still adhere to a creational vision — even banning revolutionist theories from schools and universities — others no longer believe in the traditional interpretations of God and the Universe. Even so, a significant number of representatives of the latter current still believe in something "indefinable".

Since the existence of God as the first principle has been put in doubt by scientific findings, the *causa sui* principle could as it were take its place, in which humans could be seen as masters of at least their own world. Although in the last few decades this view has come under serious pressure from genetic determination, the thought that man's rationality makes him superior to other beings on earth and allows him to give meaning to life, is not waning. It is that very thought which can lead to an egocentric and instrumental logic.

Within the scientific Enlightenment worldview, a belief in anything undefined is regarded as rather outlandish, or else, Lyotard's "différend". Be-

lieving can by no way be captured within the two-dimensional potential frame of reference that determines the image of the human self. Differently expressed, the two potentialities of the Enlightenment framework are incapable of satisfying all man's needs to feel human, although it is tacitly — but not unconsciously — presumed they can. Part two of this article, introducing man's potential to be situated in a larger, meaningful whole, intends to make clear that believing is one way of expressing this potential. However, we also want to make clear that it is not the only way. Where we are up to is the *conceptual recognition* of this potential. Today, this recognition seems to have become conceptually excluded, precisely and lamentably because of a discussion taking place on the level of some of its articulations.

To take up the thread of the article: to be free man needed not only to abolish magic and religion, but also to have some control over the world.[h]

As we have seen, scientifically used epistemology stimulated an "objectivist" detached stance towards nature. For quite some decades now, quantum physics has been supplementing objectivity in science by the paradigm of indeterminism and participation as a way for knowing reality. However, although popularised,[i] this knowledge has never really challenged the detached objectivism approach to social reality. So in its pursuit of social progress, the Western world is still led by a "rationality" whose conceptual meaning is intrinsically associated with the meaning of "efficiency", "controllability", detached concernedness, and implicitly, the power to change. Because of this tight conceptual connection, any changes can only occur over long periods of time. That is why, for instance, although alternative views of sustainability have conceptually already moved from the romantic naïve (irrational) to the rational forum, they are still being considered too soft to be able to play a role in leading the world to progress.

b. Self-interest

Next to disenchantment, another very important conceptual thought has

[h] "Control" as such should not always be perceived in a negative way, as is the case in some alter-globalisation movements. By controlling circumstances we also mean, for instance, controlling diseases such as pestilence and cholera by way of science.[22]

[i] A great many popular science books have re-enchanted man's existence, such as "What is life" , Erwin Schrödinger, or James Watson, "In Search of the Double Helix" . The dissemination of popular scientific ideas entered a new era when television became interested in the matter. Many, mostly BBC, series followed Charles Bronowsky's original "The Ascent of Man" . There has also been an exploitation of archetypical science models by the popular entertainment business in films such as Star Trek, Star Wars, The Matrix, and many other, often fascinating philosophical questions about the nature of our world and man's place in and relation with this world are put forward.

been linked to rationality. It is the discourse that maintains that, in order to be rational, humans need to think in terms of their own benefit. If we trace back the historical line of this idea, we can see that in earlier times self-interest was considered a vice.[j]

Mandeville seemed to have been one of the first to reformulate that principle. He stated that egoism can have positive effects on society. The same idea was taken up by Adam Smith and later by John Keynes. Both these economic scientists were optimistically persuaded that self-interest would lead to the benefit of all people. The invisible hand of the market would help the process of redistribution. Keynes made a plea for self-interest on rational grounds, arguing "that fair is foul, and foul is fair, for foul is useful, and fair is not. Greed, usury and precaution will have to be our gods for a long while. For only they are able to guide us out of the tunnel of economic need into the daylights".[24] He — and others — presumed that these vices would be overcome by virtue once abundance was achieved.

In order to make predictions and calculations, economic theories assume that humans are employing relevant efficiency-based economic rules all the time. They presuppose rational agents looking for maximum profits. Of course, scientists know their basic assumptions do not totally overlap with social reality, considering them only appropriate working definitions. However, somehow this implicit knowledge seems to have disappeared along the way so that today we are stuck with the awkward situation of a fusion of economic egocentrism and rationality. The "*homo economicus*" image is deeply engraved in the minds of people as a truly inherent human component. People tacitly believe they have to live up to it.

A firm interiorisation of the economic and rational connection favours self-interest, rationally legitimising it as a positive thing. As a consequence, the economic discourse transforms opposed perspectives — such as the act of giving — into "le différend", because disinterested behaviour cannot be understood anymore within a culture whose members pursue their own interests and profit maximisation. Godbout and Caille make this lucid by showing how any act of giving must necessarily be considered an odd thing from the perspective of economic thinking. He states that economic

[j]Notwithstanding — or maybe precisely as a reaction to — the fact that the Hobbean discourse paints another kind of human "being" , according to which people will relentlessly choose the best for themselves, ignoring other people's states of being in the war of every man against every man.[23]

scientists do not understand why gifts still exist. They attempt to find an explanation by pointing to the vestiges of an older morality or a supposing that a gift is a form of self-interest. Godbout illustrates very keenly how a different vision is possible if we invert the perspective of human functioning. Instead of starting from the premise of economic instrumental self-interest, and seeking explanations for the supposedly bizarre phenomenon of a gift, he postulates that humans have an urge to give. The important question then is what mental and actual processes prevent people from giving.[25,26] In suggesting this alternative, Godbout is offering an adjusted vision of human self-understanding. This vision is certainly much more in line with daily social reality, since people's exchange of material and immaterial things is still often based on disinterested giving. We are convinced that an active encouragement of the gift discourse would strongly counteract the discourse on egocentrism — and hence its effects on society and the environment. It would provide a mental and conceptual discourse about how people are or ought to be, allowing them to recognise their implicit behaviour, and allowing such behaviour to be considered natural rather than bizarre or odd.

Lastly, the economic efficiency discourse, in addition to profoundly influencing the personal conceptual level towards a selfish instrumental road, also has an all-embracing effect on the way people structure their society. Important in this respect is the fact that bureaucratic institutional structures unintentionally direct people's thinking. They have an important influence on the way of functioning of individuals embedded in their context. This context is very accurately described by Habermas in his *Theorie des kommunikativen Handelns* as "the colonisation of the lifeworld by the instrumental-strategic imperatives of the system"; a colonisation which he sees as still going on today, and which has as a consequence a great number of crisis phenomena, such as loss of collective insecurity and meaning, and loss of tradition; or, on the personal level, alienation and psychopathologies.[27] What we want to make clear here with regard to the conceptual level is that due to what one could call "actualisation inertia", it is much more complex to change discourses once they are firmly embedded in these bureaucratic societal structures. The longer a certain articulation has been in the running, and the more it has been translated into certain institutional structures, the harder it is for this specific articulation to die a silent death, and the more difficult it will be for another articulation to develop. Otherwise stated, it will become very difficult to see the existent articulation (for instance the fusion of economic egocentrism/instrumentalism

with rationality) as *one* of several possible articulations; instead, it will be conceived of as the *only* articulation possible.

2.2.3. *The discourse on all meaning coming from within*

The question why the articulations of the rational potential and the potential for self-expression in combination lead to a conceptual perspective of egocentrism and an instrumentality, while they are in fact intended to serve the goals of liberation and personal development of all, can partly be answered by referring to *man's ignored or concealed tendency to follow guidelines.*

From within the neo-liberal discourse, people are enlightened by the idea that all meaning comes from within themselves. Western individuals tacitly learned that their culture — as opposed to other cultures — is not led by an overall, externally imposed worldview. Western culture is supposed to have freed itself from meta-narratives such as religion or Marxism.[k] As a result, people within that culture are thought to independently pursue an autonomous inner voice, and not any longer to follow parameters imposed from the outside.

According to Kymlicka, Taylor has made it convincingly clear that this commonly accepted perspective fails to acknowledge part of reality. Taylor elucidated that we are guided by so-called hypergoods in such an implicit way as to make us perceive them as basic moral intuition. These autonomous basic intuitions are revealed as deep collectively acquired values ("goods"), which are subject to change over long periods of time.[l] So there is a collective level by which we are influenced, and which we cannot just ignore. The Flemish philosopher Burms concentrates more directly on the insights behind this phenomenon,[29] stating that something is appealing the moment we are fascinated by it. Our fascination stems from our cultural background, not merely from an independent choice, coming out of the depths of ourselves. *Prior* to the choices we make (to become an artist, a judge...) we are always *a priori* appealed by a cultural constellation.[m]

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[k] J. F. Lyotard was the first to introduce the idea of "meta-narratives" or "future-oriented myths" , which he explained in greater detail in Ref. 28.

[l] Ref. 16, p. 221.

[m] Liberals such as Rawls and Dworkin recently acknowledged the social and cultural embeddedness of a person. The debate on societal matters between liberals, communitarianists, and people having a point of view somewhere in between has since then shifted to the *extent* of this context (a small or a thick cultural context) and — maybe even more — to what degree the state should intervene to protect this background. See

Using Taylor's and Burm's insights, we want to focus on *recent* guidelines people have been tacitly receiving through the combined articulations of the rational potential and the potential for self-expression. These are fresh guidelines, and have not yet been interiorised, so that they cannot yet be considered hypergoods. Indeed, they are contra-intuitive to the basic intuitions Taylor describes. But they nevertheless have an appealing tendency, because they are provided by the community and are part of our cultural constellation. Even if these recent guidelines may at first seem contra-intuitive, they strike us as "true" due to their rationale, so that people may implicitly come to regard them more and more as pursuable.

By way of illustration, we will give a concrete example of how these fresh guidelines appeal and of the appeal itself. During the period in which we prepared this article, the far-right party of Flanders gained many votes. To counteract this movement, the other parties agreed to establish a "cordon sanitaire", committing themselves not to govern with the above party. Contrary to their policy, however, policymakers adopted more and more items from the far-right party in their discourses. Their arguments for doing so varied, an important one being that the people were voting for such a line of policy. And since they, the policymakers, are their representatives, democracy requires that they comply with the wishes of the citizens. Also, policy-makers saw this approach as a more subtle way to diminish the far-right party's momentum.

In this kind of argumentation one can clearly sense the ignorance of the principle *that* people follow guidelines, as well as the ignorance of the compelling force of guidelines. Citizens do not autonomously vote for something in the sense that they follow their own original ideas from within, as is usually assumed. Instead, they respond to something which is appealing to them. *Today's* appeal of simplistic racists' ideas is at least partly due to the fact that policymakers are adopting themes from the far-right. This encourages a certain way of thinking to become generally established. Since the Holocaust, this way of thinking had culturally been considered improper and banned to the margins of what was thinkable, as a result of which these ideas could *not* be appealing anymore. Any solution aimed to counteract the far-right should therefore not be sought in adopting their discourses but in a conceptual redefinition and re-categorisation of these themes in such a way that the racist perspective may again become the odd element, "le différend". By bringing to the fore the ethical perspective

Ref. 16, p. 270.

and the potential to be situated in a larger and meaningful whole, as this paper seeks to do, we may be taking a first step towards a necessary change in perspective on a more fundamental level.

Concluding, one could say that the implicit but conscious recognition of the rational and self-expression potentials as fundamental potentials for the development of human selves is a positive evolution. To be able to understand ourselves as human selves, it is absolutely required that they be developed. However, because of their "potential" state, they allow different articulations or precipitations in ideas, discourses *etc.* These articulations create "différends", in the sense that they hinder the conceptual formation of certain crucial insights. In the above sections we wanted to stress that the precipitated forms of these potentials in Western culture unintentionally serve as facilitators for certain concerns and practices that nobody is really happy with. Because of the expansion of this Western perspective, it has left us with non-desired consequences on a worldwide scale.

In the second part of this article, we will suggest ways to overcome at least some of the problems present at different levels of society. It is our intention to try to undo the tacit fusion of meaning of rationalism and self-expression with egocentrism and instrumentalism. This fusion is the result of a cluster of intermediate links, including links with enchantment, economy or utilitarianism. By introducing two more potentials as founding potentials for the human self — the ethical potential and the potential to be situated in a larger whole — we aim at redefining the meaning of "being a self" or self-realisation, so as to make room for a more adapted linking of meanings. We think that trying to generate insights on this conceptual level is very basic, since it is the layer that serves as the foundation of the bureaucratic-institutional pillars that structure society. This paper only offers some first steps in this direction.

3. An Adjusted Self-understanding

In our attempt to prevent the undue development of the rational potential and the potential for self-expression, we will introduce the two additional potentialities already discussed above.[n] Although they are by no means unknown in the human discourse, they have not yet been recognised as potentials, and what is more, neither has their development been considered central to self-realisation. The ethical potential has been categorised

[n]For this section, see also Ref. 30.

as an extensive part of rationality, as our moral rationality.° Being and acting in a correct ethical way has thus been brought in relation with third persons, with the intention of reaching a global ethical society, precisely because of our rational capacity. What has systematically been neglected, heavily underestimated, or even totally misunderstood is the utmost significance the development of the ethical potential can have for leading a broader meaningful life as an individual and for societal and environmental cohabitation.

The potential for being situated/oriented has also been sensed throughout the ages, but implicitly its articulation, by way of a relation with nature, with the community and with ethics/religion, has very often been negatively connotated. The feeling of being situated in nature has been associated with Romanticism, or expressed in New Age terms. Both merging movements are tacitly associated with irrationality. Situatedness in a community, although accepted to a certain degree, is nevertheless surrounded by an air of suspicion due to its connotation with nationalism, in which a person's will is subordinate to that of the nation.[31] The view of religion as providing moral guidelines has largely fused, on the conceptual level, with superstitious bondage and lack of freedom. Religious fundamentalism is only feeding that association. There is no denying that we need to take a critical approach to such expressions, but we may have to make a distinction between "something deeper" and its *expression*. What we want to describe is this potential in its stripped, non-articulated and de-associated state, as a basic constitutive fundament for self-realisation. It might lead to a shift from eliminating or judging as a whole *the very possibility* of expressing this potential, to trying to influence the way this potential is expressed.

The following sections will put both capacities in a new light trying to avoid the obsolete and dichotomising categorisations referred to above. Insofar as this has not become clear already, we wish to point out that, although both potentials are treated separately here, they are strongly interwoven; in fact, the same can be said of all four of them.

3.1. *The Ethical Potential*

If we say that humans have an ethical component, we are telling nothing new, of course. Quite the contrary, what it means to "be" and "behave

°Jürgen Habermas, as one of today's main authors in the field of ethics, also very clearly links (normative) ethics with rationality and (thus) universality.

ethically" has featured strongly in the self-image of the Western human self throughout history. However, the kind of ethics we want to stress differs from this generally accepted vision. As we said in the introduction, it is a very common thought that humans are ethical *because* they are rational. This assumption has resulted in categorical imperatives, clear and strict rational guiding rules on how to act in moral situations.

Of course, we do not deny that there is a rational element in the ethical, but ethics cannot just be reduced to its rational component. Ethics is made up of a series of elements. The following aims to describe these different constituents of ethics, pointing out that by reducing ethics to the rational level, it is paradoxically nipped in the bud.

According to Levinas, ethics is in the very first place not something we can rationally learn, but something we experience. Experiencing may even not be the right word, since this concept might still refer to a conscious level. What Levinas is pointing to is the level of the pre-reflective. To fully capture these constituent parts of ethics, we have to become more deeply involved in his line of thought — or at least, our (simplified) interpretation of it.

Levinas in fact implicitly perceives ethics as a potential, considering it to be formed and appealed to time and again on a pre-reflective level. This potential is articulated because of our basic ability to recognise pain and pleasure, and the ability for being touched, which is a momentary event.

The ability to recognise pain and pleasure sprouts from the very nature of human life, based as it is on shared existence and shared (existential) experiences. We, people, find our lives fundamentally valuable; in general we are intrinsically attached to it. In living this way we confidently believe we can manage the reality that surrounds us. As independent beings, we feel at home in our bodies, reaching out to the world. On the one hand, we enjoy ourselves and the world around, but on the other hand, we can experience pain or illness, which, if serious, confront us with the fact that we are dependent, being locked in our own body, and left at the mercy of others.

The two opposed aspects of independency and dependency can both be felt, which is a pre-condition for people to be ethical. Not only can we fully comprehend other people's self-attachment, we can equally understand their suffering dependency.[32,33]

To be touched by somebody's suffering is something we cannot prevent from happening. As Levinas explains, the act of being touched happens in the momentaneous. Levinas, but also Deleuze make clear that the present

is something we cannot get a grip on.[34] We can only get hold of what happened *already*, that is, the past. Of course, we can anticipate and *expect* what will happen in the future. But we can never be sure until it really happened. Hence, our mind has no active access to the immediate. Reflection is always — a fragment of a second — late.

This incapability of the consciousness to really grasp the present is our weak point, since it means that we are not in control of what happens in us at any particular moment. Our inner door is always ajar, as it were. We cannot prevent some things from slipping in, which is precisely what happens. In an instant, we are touched by a person's suffering, by the genuine vulnerability visible in the other's face. In a split second, other people break into ourselves, claiming us without permission. However, these other persons do not intend to enter our reality uninvitedly. It happens and neither of the two has any control over it. The incident is pre-reflective and in that sense, a passive event.

Paradoxically, however, our weak point is also our strong point. It opens the possibility to become ethical beings. When we are touched — pre-reflectively, in the immediate present — for instance, by the look in somebody's face expressing a unilateral but unavoidable request for help, something in us changes. We are pulled away from our own suffering and enjoyment, our attention turning from ourselves towards the other. We no longer experience this other person as something we can (in an unconscious way) instrumentally make use of, as a possible means to satisfy our needs, solace for our pains or a medium for our happiness. Instead, we will start seeing him or her as an individual self, a self we cannot just reduce to an element of our own world, but a self who, on the contrary, very much transcends us in his or her vulnerability, and whose unsolicited calls arouse a latent aspiration in us to respond. It is this ability to respond, this "respons-ability", which makes the development of an ethical potentiality in us possible. This potentiality sets a boundary for what is — ethically — considered not tolerable anymore. At such moments — starting already in very early childhood — we become ethical beings. There is no way back. This ethical potential, in its potentiality, cannot be described linguistically. In its indefiniteness, it can only be partly captured by non-conceptions as "justice" (Derrida), "responsibility" (Levinas), "no cruelty" (Rorty) or "empty law" (Lyotard). From within this potentiality, people can react differently from one situation to another, depending on the development of this potential in their personal lives, and given that every situation indeed is different.

Being touched does not only make possible the coming into "being", or the coming into "reality" of the ethical potentiality; each appeal from the other and third persons ("le tiers") addresses this potential again. Appeals are endless and pre-reflective; the possibility to respond, however, is finite. We cannot possibly respond to each appeal. Responding is therefore a semi-consciously controlled act, a deliberation. Here, reflection comes in on the subconscious — and sometimes conscious — level.

To return to the main line of this article, we will now turn our focus from the emergence and maintenance of this appeal, to a discussion of how the Enlightenment worldview makes this ethic potential a "différend". It does so in two ways. Firstly, its discourse hampers the aspiration to respond, and secondly, its discourse makes a conceptual acknowledgment of the being-touched "experience" — a core element for being ethical — almost impossible.

3.1.1. *Hampering the aspiration to respond*

As for the first point, discourses in the Western Enlightenment worldview conceptual lead our semi-rational deliberations *away* from the aspiration to respond. There is an implicit but not unconscious double, interlaced conceptual threat in which on the one hand the uniqueness of one's *own* capacities is stressed, whilst on the other hand the significance of *other* people's vulnerability is minimised. Regarding the uniqueness, we saw in the first part that this was filled in as the duty for developing our own originality, and the duty to think rationally — the latter fusing meanings with a disenchanted and self-interested economic way of thinking and acting. Since our worldview tacitly reassures us in making this choice for the "self first", it influences our semi-conscious balance between on the one hand choosing for ourselves, and on the other hand the pre-reflective touching appeal of the other in favour of an inclination to the first. As we saw in part one, and as our collective view of the self tends to ignore, in a subtle way we tend to follow guidelines.

The second part of the conceptual approach influences our view of others. With regard to our judging of less fortunate fellow citizens, the Enlightenment discourse involuntarily stimulates to adopt a perspective of caution. The visible vulnerability on the face of the other by which, in a first immediate instance, we cannot but be deeply touched, can be rationally dismissed in this Western conceptual framework. A reinterpretation of this vulnerability is implicitly encouraged by conceptually linking it to

the idea that it is all their "own responsibility and own fault because of laziness", or even worse, by suggesting that the other is *feigning* vulnerability in order to deceive us.

In theory, this conceptual evolution should leave us with a society dominated by egocentrically acting beings. In practical daily life, however, this seems not truly to be the case; people still significantly respond to the vulnerability of others. Hence, we have the awkward situation in which the conceptual framework makes people inclined to see *others* in their society as egocentric or cheaters, and yet perceive themselves as ethical beings — and act accordingly.

We saw that the Enlightenment discourse may render it more difficult for an ethical deliberation to precipitate into a response to an appeal. To make ourselves clear, we do not assume that people can or will respond all the time. Rather, we are aimed at one level above that decision. What we want to make clear is that the Enlightenment discourse — unintentionally — provides a certain image of ourselves which can lead to instrumental and egocentric self-understanding. Levinas broadens this self-understanding by conceptually re-introducing material which unfortunately has been relegated to a dark corner of our worldview. Thanks to Levinas, we can understand the significance of the ethical potential in us, the importance of unfolding our respons-ability, the desire to be responsible in order to become "truly" human. Levinas emphatically postulates the question whether we really dare to call ourselves humans if we are but concerned for our own selves.[p]

Recognising ourselves as ethical human beings, will influence our way of making choices. These choices will then still be autonomous, each time again, but the one-sidedness of the tools with which people deliberate, will be extended, which in our view will lead to more balanced outcomes.

3.1.2. *The being touched "experience", a conceptual "différend"*

The Enlightenment discourse also profoundly hampers the possibility for a conceptual acknowledgment of the being-touched "experience", because

[p]This statement, of course, is not entirely new. According to Taylor, Huntington already had such insights. To Taylor, Huntington believed that if in any way we fail to recognise the benevolence of nature, it stifles and cripples our moral sentiments. "Not believing in our own moral inclination dampens them, and recognising them gives them strength. In acknowledging the mainsprings of good in us, we rejoice them, and this joy makes them flow stronger [...] Seeing the good in ourselves and in others releases this good and intensifies it." (Ref. 10, p. 261)

its worldview hinders the vision that meaning also comes from within. Acknowledging the being-touched experiences is acknowledging that meaning can be provided from outside. In discussing the worrisome evolutions, we already mentioned the cultural conceptual level of guidelines we follow. One could see this as the first level on which reality surpasses us. There is, however, a second pre-cultural level by which we get surpassed, which we "feel" as the level of the being-touched experience. At this level, we understand that language and our thoughts are not able to capture this whole experience. In seeing somebody else's joy and suffering, one can sympathise — the result will be an approximation — but one will never be able to feel what the other is feeling. One is not able to utter fully in words what one sees in the face of the other. That is when one realises the limited capacity of language. Language cannot fully express the manifold dimensions of what is "experienced" in that pre-reflective moment. If one tries to analyse or describe it, part of it inevitably will not be grasped.

This very complex moment of being touched, as worked out by Levinas, has no conceptual place in today's discourse. In the Enlightenment discourse, the objectivistic discourse still triumphs, which states that everything is knowable. It does not leave room for the opposite thought that *not* all is knowable. As Burms says, the transcendental is depicted as a justification of the real.[35] In the language of this article, we would say that it is reduced to the tangible reality, in the sense that the phenomenon of being touched is considered totally knowable, expressable and explanable. It is assumed that nothing is left out of analysis.

It is for this latter reason that the very possibility of ethics is nipped in the bud. We do ethics wrong, we do not really understand it. Hence, one cannot expect society to encourage ethical citizenship, whilst at the same moment conceptually reducing the basic core of ethics, the being touched experience which triggers the ethical reaction, to a "différend", and thus conceptually excluding it. It matters all the more when one becomes aware that indeed citizens let themselves be guided by collective ideas, that the conceptual level makes up an important tool by which people understand the world and shape their self-understanding.

Being touched and being appealed is also what relates people to one another. It is the level on which people understand each other without words. What differs, however, is the reaction, the articulation, its cultural or contextual colouring. The more cultural colouring, in the sense of strict explicit or implicit rules on how to ethically respond in a given culture, the less possibility there will be for individual deliberation.

3.2. *The Potential to be Situated In and Orientated Towards a Larger, Meaningful Whole*

To understand what we are aiming at by conceptually bringing this potential to the mental fore, we need to de-link and re-link the meanings associated with some of the notions used in describing the potentiality, such as "being situated", or "being touched". We will first retake the notion of being touched and its surpassing aspect, by focussing on a three-ontology world and by bringing to the fore three horizons. In doing so we clarify what we understand by a larger, meaningful whole. Secondly, we will make clear what we comprehend by "being situated" and "oriented". Whilst doing so, we will try to indicate how a conceptual shift can influence our way of perceiving our relation with society and nature. Thirdly, we hope to be able to show that, for self-realisation, the possibility to develop this potential is as primordial as the development of the rational, the ethical and the self-expressing potentials.

3.2.1. *The three-ontology world*

As one of the authors already worked out in a previous paper,[36] a larger meaningful whole is subdivided into three "horizons", the ethical horizon, the social horizon and the physical horizon. We wanted to re-introduce these horizons conceptually as a reaction against the misleading conceptual frame of reference that claims that our decisions on what we wish to be bound by depend solely on ourselves. Within this misleading framework, the ethical, the cultural and the physical can be visualised only in a one-ontology world (see below), which reduces its meaning. So the ethical horizon can only partly be described as rules and norms to which we collectively adhere. The social-historical horizon can be depicted as the community we live in, as well as the community of human beings all over the world. The physical horizon seems simply to be no more than the natural environment we inhabit. However, all three worlds also have a surpassing tendency, which precisely makes up their horizontal function. It is this tendency to conceptualise them again as horizons, and not only as tangible, here-and-now worlds, we aim to bring to the fore. In mentally acknowledging their transcendent part, in making it part of our world of incontestable "beliefs", people may be able to develop more clearly a feeling of being attached to them and so indispensably feel committed to them. Articulating the surpassing tendency on a conceptual level, articulating it within our worldview may therefore encourage our proclivity for "the good".

In order to be able to take the step from a single to a multi-level dimension, to perceive these worlds also as horizons, we will rely on Habermas' concepts. We do not take over the full meaning behind Habermas' concepts; instead, we will adjust them to fit our context.

In order to develop his theoretic communication paradigm, Habermas introduces different models of acting. He states that by making choices between these models of acting, each scientist implicitly but inevitably makes presuppositions with regard to possible relations between an actor and his world. Of interest to us are precisely these ontologies, because we think not only scientists inevitably "use" them to look at the world, but also "common" people. We very much believe that the ontology of common people is very strongly influenced by their worldview, of which science is a very important part, and by which they understand the world. As will become clear, we think that — implicitly — people now have taken it for granted to conceive the world *conceptually* as a one-ontology world. However, on the level of implicit experiencing, they still live reality from within a three-ontology world. It is our strong conviction that these implicit experiences need to be implicitly — or even explicitly — acknowledged at the conceptual level in order for people to be ethical beings, and to become "full" human persons in the sense that they can be able to situate themselves in a larger meaningful whole. We will now further explain what we mean by this.

In a one-ontology world — a subject–object world —, an agent assumes but the existence of an objective world from which he can gain knowledge, and in which he can manipulatively interfere. This subject makes rational reflections with regard to the means to be used for achieving an envisaged goal. Rationality of acting here is measured in terms of "efficiency" and "truth". An example of this world is the economic way of acting, or the scientific objectivist way of doing research. Interesting to us is that Habermas also situates Adorno and Horkheimer's theory of instrumental rationality at this level.[q] He states that the conceptual apparatus of classical philosophy of consciousness allows showing only *the fact that* something is lost when reason is instrumentalised, but not *what* is lost.[r]

The two-ontology world Habermas is referring to, is the one in which

[q] Ref. 7, p. 525.

[r] "Die Kritik der instrumentellen Vernunft, die den Bedingungen der Subjektphilosophie verhaftet bleibt, denunziert als Makel, was sie in seiner Makelhaftigkeit nicht erklären kann, weil ihr für die Integrität dessen, was durch instrumentelle Vernunft zerstört wird, eine hinreichend geschmeidige Begrifflichkeit fehlt". (Ref. 27, p. 522)

social reality is included. Of importance now is not only the objective world, but also the relation of a subject with that social world. To act rationally, one has to behave "rightly" with regard to implicit but strongly present norms and rules.

In addition to these two, a three-ontology world also includes the world of subjective experiences. Here we very much deviate from Habermas' frame of reference, in the sense that to us this subjective experience of being touched, which surpasses us, is a prime subjective experience.

Before further elaborating this subject in relation to the three horizons referred to above, an additional conceptual de-linking and re-linking needs to be worked out; this time, the re-linking concerns the need for "being situated in or oriented towards a larger whole".

3.2.2. *Being situated, being orientated towards*

The phrases "being situated in" and "oriented towards" very often have New Age or conservative connotations suggesting that no more room is left for individual freedom, with people uncritically submitting their will to that of a higher goal of a group, a culture, a nation (nationalism) or a religion (fundamentalism or animism). According to Levinas and Taylor, however, these phrases do not imply uncritically submerging, but rather refer to a position between submergence and detachment. To elucidate what we mean we again refer to Levinas.

Levinas makes clear that, contrary to what may generally be taken for granted, people are never fully at one with themselves but rather split egos. There is on the one hand an acting self and on the other hand a self that is reflecting about that acting. The reflecting can occur simultaneously with the acting. The question Levinas asks himself is whether both the observing self and the acting self are the same. He considers the answer to be positive, since people experience themselves as single united beings. On the other hand, people also experience two different split-up selves. So, whilst we feel very much at one with ourselves, our minds cannot get grip on both the observer and the observed at the same time. Although logically not correct, for Levinas both contradicting feelings are true feelings.

A similar phenomenon is recognisable in the pain and pleasure referred to earlier in this article. Although mental or physical suffering can take up a considerable amount of conceptual space in any person's life, people never entirely *are* that suffering. Likewise, while enjoyment can reach deep down into all of our fibres, we are not the joy.[32]

3.2.3. *The ethical horizon, the social-cultural-historical horizon, the physical horizon*

In relation to the ethical horizon, the social-cultural-historical horizon and the physical horizon, we will now re-introduce a similar awareness that is transcendental or surpassing yet without total submergence. We very much think that a re-introduction of these horizons may produce a shift at the conceptual level which may have an influence on the way we look at problems on the individual, the societal and the ecological levels. More precisely, there may be an interlaced shift in how we understand and experience the world, and how we understand and experience ourselves.

a. The ethical horizon

The *ethical* horizon is not visible in a one-ontology world.[s] One might wonder whether it is depictable in a two-ontology world, since the norms and rules in this world seem to reside on the conscious-implicit level. The ethical horizon we are referring to is also implicit, but on a different level. Taylor, who worked out this horizon, clearly shows how our identity can be broadened up by recognising that we are embedded in an ethical context.

In the first chapters of his *The Sources of the Self*, Taylor convincingly illustrates how science uses a one-ontology perspective to study the human self, and how the ethical as a guiding principle is thus made a "differend". As he describes, science reduces the human self to the following four points. a. Man is an object of study, to be taken "absolutely" or in its own "objectivity", in the sense that what people "mean" to each other is of no value. b. What counts is what is "there", no matter the interpretations offered by subjects. c. It is believed that the object — the human self — can be grasped in explicit descriptions. d. No reference to its surroundings is necessary to understand what a self is.

For Taylor, this is not the way to understand a human self, or to attain self-understanding. What identifies us is layered and complex. However, the moral framework we live in is of the greatest importance. It is so important that it would be impossible to step outside its framework, for this would damage us as persons. As Taylor puts it,

"My identity is defined by the commitments and identifications

[s]In having an ethical horizon within the potential to be situated in and orientated towards a broader meaningful whole, it should again become clear how interlinked these potentials all are, their division into four potentials being but a theoretical structure to bring important basic experiences back into the conceptual world.

> which provide the frame of horizon within which I can try to determine from case to case what is good, or valuable, or what ought to be done, or what I endorse or oppose. In other words, it is the horizon within which I am capable of taking a stand. [...] What this brings to light is the essential link between identity and a kind of orientation. To know who you are is to be oriented in moral space, a space in which questions arise about what is good or bad, what is worth doing and what not, what has a meaning and importance for you and what is trivial and secondary [...] We are all framed by what we see as universally valid commitments, and by what we understand as particular identifications. We often declare our identity as defined by only one of these [...] but in fact our identity is deeper and more many-sided than any of our possible articulations of it."(Ref. 10, p. 27)

In other words, looking for meaning within a framework defines us as human beings. Questions such as "what kind of life is worth living" or "who am I" are very much intrinsically related. These questions take a considerable amount of our lifetime to be answered, a process which is hampered because Western culture tends to pull people away from these existential questions by ignoring their worth. However, any person's identity will conceptually broaden once they have found out which values are more or less stable in their lives and which are of less importance. Knowing our drives tends to make us firmer. Knowing that own ideals for the good correspond with a larger collective project, will widen our identity even further.

Recognising a transcending horizon is different from uncritically following narrow moral laws. Taylor precisely refers to today's shift of such narrow guidelines to fuzzy meanings. To Taylor, it is our inevitable modern condition to search for an adapted individualised meaning of these fuzzy terms, since today such concepts as benevolence only provide open advice, which will need to be revised from case to case. However, Taylor also correctly states that for new, original meanings to be understood, they will always need to be embedded in the (historically) existing range of ideas about it:

> "A human being can always be original, can step beyond the limits of thought and vision of contemporaries [...]. But the drive to original vision will be hampered; will ultimately be lost in inner confusion, unless it can be placed in some way in relation to the language and vision of others."(Ref. 10, p. 37)

Nowadays, meaning is dependent on our powers of expression. The discovery of the transcendental framework and our awareness of it are interwoven with our capacity to give these hypergoods a place and a new meaning.

Taylor makes in his book another point which is very central to this paper. He makes clear that we cannot be convinced of somebody else's moral values through rational arguments. Instead, such moral values will need to "appeal" in some way, it should "do" something to us, "touch" us before we will consider making them our own and try to live accordingly. However, once we do so, once we are convinced, we will feel as if we have taken a step in the "right" direction.[t]

b. The social-cultural-historical horizon

According to the Western Enlightenment worldview, the *social-cultural-historical* horizon is usually depicted as the "objective" tangible community and state we live in. In a one-world ontology, the community or state can then be considered an object which provides facilities people make use of in order to enhance their personal development. A community can also be visualised from within a two-world ontology, in which basic social norms and rules establish our living together. Depending on place and context, people invariably see themselves as belonging to a particular family, social stratum, a group, a culture, or a nation. In the Western world, there was a strong reaction against this perception of belonging, since it was interpreted differently, namely as a bondage to state or church (which it can also be). From within their one or two-ontology Enlightenment framework, people seeing the bondage could not simultaneously see the worth of belonging, which is only clear in a three-ontology world. Hence, the difference with the two-ontology world is not visible but conceptual. It has to do with acknowledging the crucial relevance of this socio-spatial room to our self-definition and our vision of the world. The question of "who am I" is inextricably linked up with the question of "where do I belong to".

[t]In *The Sources of the Self*, Taylor restricts this orientation to the collective-cultural values that a society has been building up during ages, and that have implicitly but not unconsciously condensed in our minds. Taylor does not go into the pre-reflective as Levinas does. However, we think that a combination of Taylor and Levinas will help us resolve a problem Taylor is faced with. Taylor very much emphasises that the ethical orientation cannot be but on the cultural-collective level, but he implicitly states that they are very good ones. Because of this, he is implicitly judging aspects of other cultural frames of references. It would seem to us an appropriate way out to define some of Western hypergoods as pre-reflective and pre-cultural appeals. Only the responses to them are cultural.

Its importance can be deeply felt the moment we have to do without all these elements which definitely form our identity, and which we seem to take for granted. A study by the anthropologist Roosens on the Huron Indians in Canada provides insights into its mechanism. Forced to move away from their holy ground, and having lost their common stories and traditions, this tribe created a new myth of origin with specific indications of their descent.[37] This restored to the individual members a common — conceptual — past and identity from which to rebuild their own personal identities. Central to them were not only the here and now societal actuality of rules and norms, of institutional structures and artefacts. Of even more significance were the *meaning* these elements had for them on a broad, conceptual horizontal level, to which they could feel they belonged as part of a continuation of past, present and future.[u]

Our point is that only the very moment we discover this attachment conceptually, we can start to experience its basic essential and existentialistic worth. Discovering this attachment *is* the experience of a transcendental reality, of which we are a part and which surpasses us. Again, attachment and merging are two different things. If any individual's identity merges with that of the group to the extent of wholly coinciding with it, the result will be an intolerant "we-perspective", which is clear today in growing Islamitic and Bushean fundamentalism. However, the excesses of fundamentalism and nationalism should not be used as a reason for making a "différend" of these feelings of attachment, and being touched, for it is these feelings and their implicit and explicit articulations that enable social commitment. People will be much more eager to commit themselves to social ends when they are able to partially identify in a positive way.

c. The physcial horizon

The third horizon is the *physical* horizon. In a one-ontology world, this horizon totally overlaps with nature. As we have said, in the Western worldview, people have learned conceptually to perceive nature as mere disenchanted material. The world supposedly is no more than a tangible

[u]It would be interesting to compare our ideas with the political-philosophical discussion on citizenship between the communitarist and the liberals, as described with great nuance by Kymlicka. As Kymlicka indicates, we ought to have a richer and at the same time more subtle understanding of the practice of citizenship. What the state needs of its citizens cannot be exacted from them. Commitment of citizens should be voluntary. A commitment on this basis precisely seems to be possible when citizens can conceptually again recognise a three-ontology world, which in fact they already experience. See Ref. 16, p. 284.

reality in the here and now, which we can study objectively. The one-world ontology leaves conceptually little space for a mental image or articulation of nature from the perspective of a three-world ontology. It is very difficult to articulate it that way in our language, since its connotations are rather negative, as we have seen. Yet, at the practical level, all people seem to have at least some experiences which they can only express within a three-world ontology. Such experiences very often concern esthetical experiences in nature, for instance when people are awe-struck by the force of nature, or on the contrary by the silence and harmony pervading a particular panoramic view. These "being touched by nature" experiences make us "experience" and "know" that nature is more than the tangible, that nature surpasses us. We "realise" its greatness because of its beauty, and its destructive and creative powers. We can feel these powers in us. However, as Levinas explained, as humans, we do not fuse with ourselves, with our pains, with our pleasure. We remain autonomous beings while having an experience of uniting. A similar process occurs when we are in nature. In nature, at such moments of linkedness we feel that we are receiving energy and strength, without however fusing.

As is the case with the two previous horizons, to be considered a horizon and not merely outer tangible here and now reality, these experiences of "being touched" should conceptually receive full articulation in the Western worldview. They are basic, not only for the self to understand that it is part of this larger world, but also in order to create potential commitment. If people seem to care more for the things of which they consider themselves a part, it is paramount to at least recognise this feeling in its stripped, de-associated way.

So, central to the recognition of the ethical, the social-cultural and the physical horizons is the "being touched" experience as a pre-historical, pre-cultural and pre-conscious event. Being touched is an immediate experience, something we receive in the immediate present. The being touched awareness triggers the potential to be situated in and oriented towards a broader whole, a potential which also encourages the ethical in us. The very moment one feels attached to society or nature by way of recognising its surpassing value and by acknowledging the meaning it can have for one, a latent commitment will be generated. We will be more inclined to care for something when we feel attached to it. Moreover, because of this being touched, life itself can be conceived of as "broader". The potential to be situated, which is interlaced with the possibility to orient oneself towards something, can make one's life more meaningful, because one can sense an

additional depth. Life does not begin and end by oneself, but represents a much broader frame of reference of which one conceptually feels a part. It may also lead to feeling closer to oneself.[v]

However, as we have said, because of the complex fusing of the rational potential and the potential for self-expression with egocentrism and instrumentalism, one is pulled towards perceiving society and nature as there for one's use, and ethics as only residing in oneself. The essential meaning of feelings of linkedness cannot be uttered in our worldview. They still are a "différend". Because of this gap between conceptual voicing and feelings, and because of the dominance of the power to express, we might tend to implicitly rate these experiences as of low importance, and hence as "negligible". In doing so, we again nip both the ethical potential and the potential to be situated in a larger meaningful whole in the bud.

As repeatedly stated, what we have tried to achieve in bringing back these horizons to the conceptual worldview is to deliver some extra elements on the level of deliberation, so as to enable people to make appropriate autonomous choices. People always take decisions within a frame of reference. They never do so in a frame-less context. We consider the existing frame of reference too narrow, because of which it even does not accord with some of our pre-reflective "experiences".

3.2.4. *Developing the potential to be situated in a larger whole*

In this last part we will try to make clear that people, whilst this potential to be situated in and oriented toward a broader meaningful whole has not yet been acknowledged on a conceptual level, seem to be capable of developing this potential anyhow. Important ways in which they succeed in this, are precisely by developing their rational potential (for example, by studying) and their potential for self-expression (for instance, by practising art and music). It links people with themselves and a broader meaningful whole. However, not all people arrive at doing so. If they are unsuccessful in finding means on their own, people may be inclined to look for compensation to the

[v]We realise that this kind of short phrasings may lead to a miscomprehension of what we mean. It may suggest a harmony model. We do not intend to say that because of this potential the self will become "at one" with itself. We rather tend to support the conception that a self is an ever changing entity; that is why we introduce the potentiality idea. Further research still needs to be done as to how a changed self-understanding as we see it, relates to the philosophical conception of an identity, expressed by authors such as David Lewis, Robert Nozick or Derek Parfit, see for instance Ref. 38; or more existentialist-minded authors such as J. Golomb.[39]

ideology of neo-liberal economy, combined with the (utilitarian) ideology of free will and autonomy, which — in an awkward way — conceptually is not acknowledged as serving such a function.[w]

The result may be only a small opportunity for developing the potential to be situated, which in itself may be enough. However, some people may become aware of a form of alienation. Three concrete examples may clarify what we mean, which in reality of course are not so strictly demarcated.

a. Some people are appealed by the economic/free will discourse and really feel good the moment they can reach its goals. Their aspiration to be situated is then satisfied by way of ego-centrality, in which having an opinion, or making choices of one's own is what is meaningful. Their aspiration can also be fulfilled when they feel they are somebody because of their economic prestige and social status making them feel socially embedded. Although people may perceive themselves as "happy" in these circumstances, we still consider this a limited form of happiness, which could be broadened if only they realised that for genuine self-realisation the ethical potential and the potential to be situated in a meaningful larger whole, can be more fundamentally expressed.

b. If people are unable to reach the desired goals referred to above, they may seek to compensate this by riding someone else's status, identifying with it and thinking positively of oneself by being friends with that other person or by living strictly according to norms and values of a society or subgroup; or again, by embarking on an ongoing competition with the neighbours. Ms Bouquet, the protagonist from the English series "Keeping up appearances" may serve as a striking example of such dwarf forms of being situated in a larger whole.

c. There may be people who take the above Enlightenment ideas to be implicitly true and try to adhere to them, but without identifying with them, and also without either knowing or being appealed by alternatives. Such people feel a genuine aspiration to be situated in a larger meaningful whole, but have no way of expressing it within the existing framework. They may live with that uneasy feeling that there is more to life, without being able to express their fundamental desire. As psychologist Cushman states: "The self seeks the experience of being continually filled up by

[w]The Belgian philosopher Ignaas Devisch maybe too firmly states that we are not only "bildet"; we are formed in a perfidious way. Not only does the hegemonic ideology deny its own non-neutral state; argumentatively it is made impossible to question the ideology, since in doing so, it is said that one is harming the "public reasonability".[40]

consuming goods, calories, experiences, politicians, romantic partners, and empathic therapists in an attempt to combat the growing alienation and fragmentation of its era."[41] Or as Kanner and Gomes put it: "American children come to internalise the messages they see in the media and in society at large. They learn to substitute what they are told to want — mounds of material possession — for what they truly want. By the time they reach adulthood, their authentic feelings are so well buried that they have only the vaguest sense that "something" is missing. Having ignored their genuine needs for so long, they feel empty."[42] A feeling of alienation may be the result.

4. Epilogue

This article set out by making clear that people in the Western world build their self-understanding on a set of assumptions, which we defined as two grounding potentials, the potential to be rational and the potential for self-expression. In the first part we traced their origin and development. We pointed out that, because of their potential structure, their articulation may change. We tried to demonstrate how, unintentionally and because of a clustering of meanings, their development indeed tends to be twisted. We interrelated that twisting with problems on the individual, societal and environmental levels.

In a second part, we introduced two more grounding potentials which in the Western worldview are "le différend" in conceptual terms, in order to broaden our self-understanding and our understanding of the world. Making these potentialities explicitly visible can change the perspective of how to think and express oneself as a human being. People might visualise more clearly what it means to be ethical and being situated in a larger whole, and the importance it has for self-realisation. From within this context, people can still make their *own* deliberations, but the scope of available options will be enlarged, so to speak. Instead of a range of conceptual messages largely inciting one to choose for oneself first, the widened scope includes the importance of fellow citizens and the relation with the world as factors to be accounted for in striving to become a truly human being. As a result, deliberations may still tilt towards choosing for oneself first — which in itself is not negative — but because of other prospectives having come into the conceptual fore, the degree in which this will happen is quite likely to diminish.

In order not to interfere on the personal level we have tried — as much as

possible — to introduce these two potentialities and the associated horizons in their naked, non-articulated state. However, any expression in language irrevocably implies articulating and leading the mind in certain conceptual directions. Yet, while we hope that the concepts used may indeed lead to a conceptual recognition of this potential, we equally hope that at the same time they will leave ample space for new interpretations.

In this paper, the descriptions of the ethical potential and the potential to be situated in a larger meaningful whole are only at a preliminary stage. Articulations require considerable fine-tuning, while concepts should be more clearly defined and deepened out. This is envisaged for the near future. Any suggestions will be much appreciated.

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TOWARDS A NEW DEMOCRACY: CONSENSUS THROUGH QUANTUM PARLIAMENT

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We compare different actual forms of democracy and analyse in which way they are variations of a "natural consensus decision process". We analyse how a "pure consensus procedure" is open to boycott of a minority, and how a "consensus decision followed by majority voting" is open to "false play" by a majority. We introduce a "random consensus procedure" in order to come closer to a natural decision process, and investigate how for such decision procedure false play of a minority is plausible to happen. We introduce the combined notion of "quantum parliament" and "quantum decision procedure", and prove it to be the only one, when applied after consensus decision, that is immune to false play. We define a new form of democracy applying a quantum consensus system for its decision procedures.

Keywords: democracy, majority, consensus, decision process, natural, procedural, boycott, false play, random, quantum parliament, quantum consensus

1. Introduction

The aim of this article is to present a proposal for a new form of democracy. We will give an explicit description of the structure of this new democracy in the sections that follow. I decided to write a contribution on this topic for the book "Worldviews, Science and Us: Redemarcating Knowledge and its Social and Ethical Implications", because I was inspired to elaborate this structure for a new form of democracy primordially while reflecting on the nature of natural processes in the world. It was when reflecting on the nature of "quantum processes" that I had a sudden insight that brought several pieces of a puzzle together. More specifically, it became clear to me how a possible remedy can be proposed for profound shortcomings of the democratic process in our actual society. I found it to be a good example of

how reflections on one scientific discipline can lead to fruitful insights in a seemingly completely different scientific field. This proposal for a new form of democracy is, however, not a mere attempt to apply insights into the nature of quantum processes to the political processes in our society. It is just as firmly rooted in personal political reflections generated by a long-felt concern about "what is going on with our western democratic systems".

For years I have been formulating, both in private and in circles of close friends, varying critiques of the functioning and practice of our democratic system. I have, however, never made an effort to write down any of these analyses, except for a short text that however remained in the form of a preprint, and its English version.[1,2] Finally, a variety of reflections came together as pieces of a puzzle and, while I was reflecting on the nature of quantum processes, made me see how a new form of democracy could be presented that would be worthwhile considering as an alternative to our current models.

2. Democracies

The word "democracy" originates from the Greek "demos" ("the people") and "kratein" ("to rule"). Hence the original meaning of democracy was: "Rule by the People". When referring to "a democracy", we therefore mean a form of government in which ordinary citizens take part, in contrast with a monarchy or dictatorship.[3,4]

This article concentrates on the type of democracy that is now spreading all over the world, and that emerged in West-Europe in the past centuries, with roots in Ancient Greece.[5,6] This type of democracy is often called "representative democracy". It comprises a form of government in which voters choose, in free, secret and multi-party elections, representatives to act in their interests. Globally, in 2004, a substantial part of the world's people live in representative democracies, including constitutional monarchies with a strong representative branch.[4]

Let us call a representative democracy that works along the mechanism of "majority voting" a "majority rule democracy". In practice, this means that a specific proposal that is debated in a nation's assembly of representatives, *e.g.* parliament, will be accepted if and only if more than 50% of such representatives vote in favour. If the 50% is not attained, the proposal is rejected. A higher percentage of votes in favour is necessary, usually two thirds of the totality of votes, if the proposal introduces a change in the constitution of the nation. This means that the constitution plays the role

of a more stable and less easy to change set of rules.

2.1. *Majority Rule Democracy*

> "The strongest is never strong enough to be always the master, unless he transforms strength into right, and obedience into duty" (Jean Jacques Rousseau in Ref. 7)

We want to concentrate on the aspect of majority voting that takes place in a majority rule democracy. Majority voting constitutes in effect a kind of "right of the strongest" in disguise. If in principle the majority always gains, it is the biggest group, and hence the strongest opinion, that always has to be followed after the voting has taken place. One of our critiques of existing democracies is related to this aspect of majority voting. We want to analyse many of its aspects, and hence not only the immoral aspect, as suggested by the above quote from Jean Jacques Rousseau.[7] Rousseau argued that "the strongest is never strong enough to be always the master",[7] and hence that the "right of the majority" confers a much more intrinsic power upon the strongest than is the case for the "strongest in nature". Indeed, when a situation in nature takes place where the saying of "the right of the strongest" can be applied, *e.g.* two animals that fight, there is no certainty at all that the strongest animal will win the fight. Let us analyse more in detail why "the right of the strongest in nature" is not a "law that determines the strongest to win", because this is important to understand why we will introduce randomness in decision procedures. The reason is that nature is not deterministic. Even the strongest can loose due to the randomness involved in natural processes. Of course, to be able to make clear what we mean we need to specify first of all what we mean with "the strongest". If "the strongest" would just be defined as "the one that wins", then by definition "the strongest always wins". To define the strongest in this way can however only be linked to one fight, and hence this definition is not very useful, and it is also not the one that is used by people if they talk of "the strongest". What people mean with "the strongest" is "the one that mostly wins" or formulated in a more rigorous way "the one that has most chance to win". The fundamental indeterminism of nature makes that "the one who has most chance to win" necessarily "does not always win". In a majority rule democracy however there does exist an "absolute right of the strongest", which makes that the strongest always wins. Apart from this ethical aspect, we will come to the conclusion that there are other aspects that make majority rule democracy not the best

candidate for a democracy.

It is commonly accepted that a majority rule democracy should not be identified as an ethical form of democracy. A majority rule democracy is defended usually for purely pragmatic and practical reasons: it is argued that other types of democracy, the ones that do not adopt the majority rule, are inefficient, because decision making takes too much time and energy of the group of representatives. Let us consider the most important of these other types of democracy, namely the "consensus democracy".

2.2. *Consensus Democracy*

Consensus democracy is the application of consensus to the process of legislation. Consensus is a process for group decision-making. It is a method by which an entire group of people can come to an agreement. The input and ideas of all participants are gathered and synthesised to arrive at a final decision acceptable to all.

Consensus decision making is of a higher ethical standard, because it is based on the principle that every voice is worth hearing, and that every concern is justified. If a proposal makes any number of people, even if only one person, deeply unhappy, it is considered that there is a valid reason for that unhappiness, and that ignoring it might be a mistake. The pursuit of consensus not only aims to achieve better solutions but also to foster a sense of community and trust. With consensus, people can and should work through differences and reach a mutually satisfactory position. It is possible for one person's insights or strongly held beliefs to sway the whole group. No ideas are lost, each member's input is valued as part of the solution.

But, there are good reasons to be sceptic about a consensus democracy in practice, because indeed it will often take a very long time to reach agreement. This makes a consensus democracy, although ethically of a higher standard than the majority rule democracy, not a very useful form of democracy in practice. It often happens that new institutions start with the implementation of a consensus democratic structure, because members can feel safe then that they will not have to submit to a majority vote decision whose outcome would be very bad for the people they represent. The European Union is an example of an institution that makes use of such a consensus decision structure. Usually, however, such institutions tend to evolve steadily towards a majority rule democracy, the argument being that the consensus democracy "does not work in practice", and leads

to too much inefficiency. In the case of the European Union, the complaint is that many important decisions are just not taken, because if one of the members does not agree the result is that "nothing happens". The question: "Why does a consensus democratic system not work in practice?" is one of the key issues that we will try to analyse in this article. More specifically, we will define a type of consensus democracy in this article that would work well if installed. Before being able to put forward this definition we need to understand better what is the difference between a natural and a procedural decision process.

3. Natural and Procedural Decision Processes

If a group of friends decides to go for a walk in the nearby forest on a sunny Sunday afternoon, their decisions have to be mutually agreed on, *e.g.* the question "will we stop for a drink in that pub along the way?", will most probably be resolved in some kind of "natural way". What do we mean by "natural"? We mean that no "well defined procedure of how to take decisions" was agreed upon before the friends started out on their walk. This is the way that most of the decisions that involve a group of people are taken in our everyday world. We will call the decision process that takes place in this way a "natural decision process". A decision process that follows a well defined procedure we will call a "procedural decision process".

Sometimes, the distinction between a natural decision process and a procedural decision process is not strict, for example, a process that started as a natural decision process may well end up as a procedural one, if it still fails to yield results after a reasonable amount of time has elapsed. Suppose that during their walk the group of friends gets strongly divided over the question of whether they will have a drink in the pub or not, and that they cannot reach agreement including after discussing the matter at some length; it could well be that one of them proposes to vote on the issue, so that the natural decision process is changed into a procedural one, at least, if all agree to this change. As a first remark, we should note that for any type of procedural decision process going on in a group of people it will at least be necessary to have a consensus about the procedure to be followed in the procedural decision process amongst this group of people. However, although this may not seem to be the case at first sight, procedural decision processes have a deeply different structure as compared to natural decision processes. To show this is the subject of the next section.

3.1. *Boycott and False Play in Procedural Decision Systems*

Let us look in some more detail at the European Union. For many issues that a majority of the member countries agreed upon, no decisions have been taken, not even in an amended form, because some members, or indeed only a single member nation, did not agree. This has happened on many occasions within the "procedural consensus decision system" that the European Union adopts. We claim that this phenomenon does not typify the "natural decision system". If we return to the group of friends taking a walk on a sunny Sunday afternoon, and if we suppose that no agreement is reached on any of the decisions to be taken, it would be very plausible for the group to decide to have a vote on the matter so as yet to find agreement. But, even before they "decide to have a vote", many other options might have been considered. In any case, what is clear is that most probably the group of friends will not allow their afternoon to be spoiled because a few or only one of them disagrees about what the others want to do, threatening to boycott the entire walk. The reason why such a boycott by a small minority, or one person, rarely happens in everyday life, is because in everyday life no fixed decision procedure has been agreed upon. Friends intending to have a pleasant walk in the forest together will not decide beforehand on a procedure to be followed in case they should stumble upon a disagreement that cannot be resolved without a procedure. The natural decision process is open to any kind of procedure at any moment, and it is exactly for this reason that it cannot be reduced to a specific procedural decision process. A procedural decision process that can be adapted at any moment and as often as required is comparable to the natural decision process, but even such a highly complex procedural decision process would be only an approximation of the natural one.

3.2. *Pure Consensus and Majority Consensus*

The European Commission follows the simplest consensus decision procedure of all, namely "if no consensus is reached no decision is taken". Let us call this the "pure consensus system". The weakness of this pure consensus system is its vulnerability to boycotting by a small minority, which may even be a single representative. Indeed, if the procedure of the pure consensus system is known by every representative, it will be easy to boycott the whole process by just "not allowing consensus to be reached in the time available".

One of the possibilities to avoid such a boycott is to introduce a different

consensus procedure. In this procedure, a consensus is looked for initially, but if it cannot be reached, the procedure of majority voting is followed. Let us call this the "majority consensus system". This procedure is open to false play too, however. If the majority consensus system is adopted, the group of representatives will first look for a consensus, but if no consensus is reached after a given time, which is fixed before the process starts, they will change to the system of majority voting. No boycott of the decision is yet possible, but false play is, obviously. Indeed, the majority may well decide to prevent consensus from being reached, because they *know* that this will be followed by a majority vote, so that they will have the decision in the way they want it to be, without the need for consensus.

This means that the majority consensus system is open to false play by the majority, just as the pure consensus system is open to boycott by the minority. Let us remark that in majority democracies often decisions are made following unconsciously a majority consensus procedure. Indeed many time first a consensus will be attempted, and if this fails, voting along a majority procedure will force the decision.

Both procedures, pure consensus and majority consensus, are very different from the natural decision process that we find around us in everyday life. Can we find a procedural model that resembles more the natural decision process?

3.3. *Random Consensus*

We remarked already that the presence of indeterminism is what characterises the natural decision process. Let us introduce a decision procedure entailing randomness.

First we make the situation that we are considering somewhat more concrete, such that we can look more systematically for alternative procedural decision models. Suppose that an assembly of representatives consisting of n people is gathering, where n is sufficiently large, for example $100 \leq n$. They discuss a specific measure and different decisions in relation with this measure are considered and proposed. Suppose that after a period of discussion two alternative decisions are left, so that the assembly will try to reach consensus considering both of them. However, no consensus ensues in the period of time available. A majority of the representatives, let us say $n - 1$, is in favour of decision A, and one representative is in favour of decision B. The two types of decision procedures that we have considered so far would produce the following results. The pure consensus system would

result in "no decision" being made meaning that, in the perceptions of the $n-1$ persons who are in favour of decision A, the one person in favour of decision B has boycotted the overall process. The majority consensus system, for its part, would result in decision A being taken.

Suppose that a society using the majority consensus system has become aware of (i) its unethical nature, and also, even more importantly, (ii) the obvious possibility of false play and, as a consequence, of a "forced decision", and suppose that it wants to do something about it. More particularly, a way is investigated to "protect" the minority, in our example, only one person out of n, who might, however, be representing a lot of people. The following procedure could be proposed, which we will call the "random consensus system". If no consensus is reached after a well defined period, a random process is organised to determine which of the alternatives will be chosen. In the case of our specific example, this would come to tossing a coin and choosing for decision A if the coin shows head and decision B if the coin shows tail. Obviously, the minority gains by this random consensus system as compared with the majority consensus system. In the case of our specific example, the one representative gains a lot, because suddenly there is a fifty–fifty chance of decision B or decision A being taken. But if all representatives know in advance that this random consensus system is going to be applied, it can be falsely used by the minority this time, in much the same way as the majority consensus system can be falsely used by the majority. Indeed, the minority, in our case the one representative who is in favour of decision B, may well boycott the process of consensus, because he or she knows that after the time for consensus has passed, the coin will be tossed, leaving him or her with a 50 % chance of his or her preferred decision being taken in its pure form, instead of a consensus decision, which, given that $n-1$ representatives are in favour of decision A, will anyhow be closer to decision A than to decision B. Our conclusion is that just as the majority consensus system invites false play by the majority, preventing real consensus, the random consensus system invites false play by the minority, equally preventing real consensus.

4. Quantum Democracy

In the introduction of this article I said that it was reflecting on the nature of quantum processes that made me see how it would be possible to propose a solution to some of the problems of our democratic system. Already years ago, I used to give the example to my students of what I then called a

"quantum parliament". Let me explain what such a quantum parliament is, and why I found it an interesting idea at that time.

4.1. *Quantum Parliament*

Suppose one considers a classical parliament, such as the ones we know. This means that we have an overall group of representatives constituting the parliament, and subgroups whose members belong to different political parties. Let us be more concrete, and suppose that we have a parliament of n representatives, and that there are five parties, which we will call A, B, C, D and E, where n_A, n_B, n_C, n_D and n_E are the number of representatives belonging to parties A, B, C, D and E. This means that

$$n_A + n_B + n_C + n_D + n_E = n \tag{1}$$

Usually, a government is composed of a collection of parties such that the sum of the representatives of all the composing parties is more than or equal to $n/2$. As a consequence, whenever the parliament has to vote on a certain proposition, the government can "in some way" obtain a majority vote for this proposition, and hence have it decided the way the government wants. This indeed is the case if all representatives of the parties that constitute the government follow the government's opinion in their parliament vote. We stated "in some way", because in principle this does not have to be and even should not be the case. Indeed, in all western democracies there is a strict division amongst the three powers: (1) the executive power, in the hands of the administrative branch of the government, including ministers, the cabinet, civil servants, the police and the army; (2) the legislative power, in the hands of the lawmakers, effectively the representatives of the parliament; and (3) the judiciary power, more concretely the enforcers of the law, the judges, magistrates and tribunals. But in practice, parliamentary decisions are often made by its members that belong to the government. Apart from this, all parliaments in western democracies decide through majority voting, which means that they give rise to a majority rule democracy.

The quantum parliament follows a probability procedure, hence partly as referred to in section 3.3, but also different. The probabilities are weighted by means of the sizes of the different decision groups. More concretely, this means the following: we develop a random machinery, such that

the parties A, B, C, D and E, respectively, are attributed probabilities

$$p(A) = \frac{n_A}{n} \tag{2}$$

$$p(B) = \frac{n_B}{n} \tag{3}$$

$$p(C) = \frac{n_C}{n} \tag{4}$$

$$p(D) = \frac{n_D}{n} \tag{5}$$

$$p(E) = \frac{n_E}{n} \tag{6}$$

From (1) it follows that

$$p(A) + p(B) + p(C) + p(D) + p(E) = 1 \tag{7}$$

which means that we can interpret $p(A)$ (or $p(B)$, $p(C)$, $p(D)$, $p(E)$, respectively) as the probability of party A (or B, C, D, E, respectively) deciding.

Hence the quantum parliament is different from a majority rule parliament, because decisions are taken following a random procedure, which means that also the smallest party can win, but it is also different from a random consensus system, where each party would have an equal chance to win. For each party, the chances to win are proportional to its size; hence the bigger a party, the greater its chance to win.

4.2. *Quantum Consensus*

Our proposal for a quantum consensus system is the following. Suppose a specific proposal is made that requires a parliamentary vote. There is a particular period of time available for seeking consensus, which is decided on beforehand. After this time has run out, the quantum parliament is to decide. Concretely, this means that a probabilistic procedure is carried out such that the majority has a probability proportional to its size to win the vote, and equally so the minority has a probability proportional to its size to win the vote. In other words, although the majority has more chance to win, the minority will always have a chance to win too, however small it may be.

It is interesting to point out at this stage that this quantum consensus system is not subject to "false play" and/or boycotting in the way that a pure consensus system, a majority consensus system or a random consensus system is. A pure consensus system can be easily boycotted by the minority, since it will not be followed by a decision vote. The majority consensus

system is typically boycotted by the majority. They know that they just have to wait for the voting to win with certainty. The random consensus system is typically boycotted again on the initiative of the minority. Indeed, the minority increases its power by waiting until a pure random decision is made. A quantum consensus system is free from all these flaws. Indeed, if the majority decided to boycott, they might lose the vote to the minority because of the randomness of the procedure. The minority will not be tempted to boycott the consensus either. Although they still have a chance to win if they opt for boycotting the consensus and waiting for the vote, their chance is definitely smaller than that of the majority, which makes this strategy less attractive to them than seeking consensus.

The quantum consensus system is the only procedure that will stimulate both sides, majority as well as minority, to strive for real consensus. It is the only procedure that avoids that there is any benefit in boycotting the consensus for either side, majority or minority. Nor does it entail the disadvantage of the pure consensus procedure, namely that it takes too long for a decision to follow. In the quantum consensus system, a fixed time is reserved for consensus, after which the quantum parliament can decide in a wink. This means that the quantum consensus system can offer a real, efficient, workable and ethically balanced consensus decision procedure.

In Table 1 we give an oversight of the different types of procedures and indicate whether they are sensitive to boycott and/or false play.

Table 1. Different type of procedures and their obstacles.

Type of Procedure	Type of Boycott and/or false play
Pure consensus	Boycott by a Minority
Majority consensus	False Play by a Majority
Random consensus	False Play by a Minority
Quantum consensus	No Boycott and no false play

4.3. *Natural and Procedural, the Aspect of Determinism*

In this section we reflect about "why there is a fundamental difference between a natural and a procedural decision process" and "why the quantum consensus system is a good model for the natural decision process" and "what these insights tell us about the nature of processes in general".

The types of boycotts and false plays that we mentioned in relation with

the different versions of procedural decision processes are only possible because decision processes are instruments used by human beings, who have the gift of foresight. Moreover, they are only possible because procedural decision processes contain a definite deterministic aspect. For example, the procedure of a procedural majority decision process is close to deterministic, which means that once the majority and minority are known and fixed, the outcome will be virtually known and fixed. And it is very well possible, and even common, that the majority and minority are known at present, eventually with a certain degree of uncertainty. If the majority is much bigger than the minority this uncertainty does however not destroy determinism, which makes that the knowledge of the majority and minority at present makes it possible to predict the outcome of the decision in the future. Boycotting and false play find their origin in this possibility of "knowing the future". It is future potential events that influence the present through the minds of the people involved in the process. Human minds manage to create a causal chain from "future potential" to "present actual". Since any procedure that is fixed and free from any randomness increases the potential of the human mind to forecast the future, it also fortifies the causal link between future potential and present actual. Once randomness is introduced in the procedural process, the potential to forecast the future will decrease, approaching the level of a natural decision process. This similarity with a natural decision process is most pronounced if the introduced randomness is quantum.

We know that causal effects of future potential to actual present also exist in the realm of the micro-world through the effect of "non-locality". In future research we want to study in which way the two are connected, and how eventually our understanding of the different types of human procedural decision processes can shed light on the nature of quantum processes. In this respect we want to elaborate the approach we have put forward in Refs. 8, 9, 10 and 11. More specifically in Ref. 10 we have introduced a mathematical model for concepts making use of the mathematical formalism of quantum mechanics. In this model, we introduce the notion of "state of a concept" corresponding to the different ways a concept behaves under the influence of different contexts with respect to typicalities of exemplars and application values of properties. Each state of a concept is described by a vector in a Hilbert space, which is the mathematical space were also the states of a quantum entity are represented in this way. We have elaborated the formalism such that also entire sentences, and in principle, entire conversations of collections of thoughts, can be presented by vectors of this

Hilbert space. Our analysis indicates that the quantum superposition state might deliver a good model for consensus as a state within a process. We plan to investigate these questions in depth within the approach that we put forward in Refs. 8–11.

4.4. *The Specificity of the Quantum Process*

The question arises whether the origin and structure of quantum randomness is linked to the function we pointed out in relation with decision processes, namely that the quantum consensus system is the only procedural decision process that demotivates the "false play type" of use of this causal "future to present effect". Indeed, this specificity of the quantum process is perhaps the reason why this process is present overall in the micro-world, and also constitutes the best model for what we have called a natural decision process. As we analysed in the foregoing sections, the quantum procedure is the most just procedure, exactly because it is immune for boycott and false play. Translated to the micro-world, the meaning of "just" could become "stable". Would it be possible to show in a more rigorous way whether the specificity of the quantum process could have selected this process in favour of all the others? There might indeed be a Darwinian element of evolution involved that in the long term makes the quantum process fitter than any other, and such that it was selected in the course of time for the entities populating the micro-world.

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NECESSITY OF COMBINING MUTUALLY INCOMPATIBLE PERSPECTIVES IN THE CONSTRUCTION OF A GLOBAL VIEW: QUANTUM PROBABILITY AND SIGNAL ANALYSIS

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The scientific fields of quantum mechanics and signal-analysis originated within different settings, aimed at different goals and started from different scientific paradigms. Yet the development of the two subjects has become increasingly intertwined. We argue that these similarities are rooted in the fact that both fields of scientific inquiry had to deal with finding a single description for a phenomenon that yields complete information about itself only when we consider mutually incompatible accounts of that phenomenon.

Keywords: quantum probability, signal analysis, incompatible observables, observation, global view

1. Introduction

Can we find a single common framework for all knowledge that in some way converges to the truth, or should we perhaps accept that truth is inevitably only meaningful with respect to the one who pronounces it, to the context in which it is produced, to the frame of reference it is presented in? The simple question we pose here is well-known to lead to endless discussion on the nature of reality and knowledge, the relation between ontology and

epistemology and between theory and fact. This discussion itself is an illustration of the dichotomic status of truth. The various stances taken by the participants in the discussion contribute to the idea of a relative truth, but the mere fact that we are still discussing the issue, highlights that we still have not given up on trying to convince each other that one truth is perhaps "more" true, than another. In the face of all various dispositions and discourses, along with the multiplicity of interpretation that is generated by these, many a thinker has given up on the idea of an absolute truth. If truth is only meaningful relative to a context or framework, we must ask: what is a context? Either one accepts the truth of a given definition of context, embracing once more the notion of an absolute truth, or one accepts that the relation between truth and context is a relative one: truth is defined by the framework that produced it, and the framework is that in which certain, given truths hold. We believe this problem of the nature of truth, and especially the popular tendency to congregate around an extreme interpretation of the idea of relative truth, has undermined the believe of rationality as a way to approach truth. Yet there are branches of human activity that embrace the absolute notion of truth, simply because in some cases, one cannot afford to succumb to relative truth. Take a court trial as an example. Despite all various and often contradictory accounts of witnesses, a judge or jury *must* believe that some unique set of events has happened which are to be judged as criminal or not by the court. It is an implicit but nevertheless crucial assumption that lies at the basis of our judicial system, that one single reality has given rise to all various accounts, and not that every testimony has the ability to create its own, independent reality. The exact sciences, by their very nature, were also among those that have shown great reluctance to accept the notion of relative truth. We can find a paradigmatic example of this struggle in the wave–particle duality in the description of elementary particles or quanta. Another area of research that faces similar problems, *i.e.* a plurality of descriptions of the same signal, is the field of signal analysis. Therefore, it may not come as a great surprise that there are certain characteristic features in the mathematical description of these two theories that display similarities. Yet both fields are usually considered only connected on a mathematical level, but to such extent that quite a few of the more important definitions in signal analysis are borrowed from earlier developments in quantum physics. We believe a very deep connection can be identified in the way these theories relate the results of observation to the state of the system which was observed. We will give brief, mildly technical introductions to both fields of study and

invoke a metaphor from analytic geometry that, we believe, shows why the similarities between the two are not coincidental, but emerged from the problem of attributing truth to different, incompatible perspectives of the same phenomenon. Finally we argue for the relevance and even necessity of combining mutually incompatible perspectives in other fields of knowledge.

2. The Birth of Quantum Mechanics

In 1925 a radically new theory of the fundamental constituents of matter and energy was born. The final form the theory was to take, emerged from two different developments, one due to Heisenberg, the other to Schrödinger. The first one started from Bohr's correspondence principle. In a nutshell the principle says that although classical concepts, such as an electronic orbit, could very well be meaningless concepts for elementary particles, the classical level should somehow emerge as some limiting case. Heisenberg had found that the mechanical equations that are usually written for the positions and velocities of a physical system, are better expressed in terms of the frequencies and amplitudes one measures in spectroscopic experiments that form the main experimental source of data of the atomic realm. The resulting theory was called matrix mechanics because the main quantities in the classical theory of matter had to be replaced by matrices. The other development took as a starting point the investigations of de Broglie's conception of matter waves. de Broglie had postulated that with each particle we can associate a wave that has a frequency that is related to its mass. Schrödinger's idea was to set up a wave equation for the matter wave of an electron revolving around an atomic nucleus. In the beginning of 1926 he succeeded in deriving energy values for the states of a hydrogen atom that coincided with the observed energy levels in spectroscopic experiments. Later Schrödinger showed that the two seemingly different approaches are equivalent in that they derive the same values for the operational quantities that they reproduce. When Schrödinger realised that the energy levels he had obtained for the hydrogen atom were simply the frequencies of the stationary matter wave, he attempted to interpret the wave as a matter wave. Matter would be spread out through space. This smeared out matter would behave as a wave and the frequencies observed would simply be a manifestation of the wave being confined around the nucleus. Similar to a flute that produces a tone that has a wave length which (possibly after multiplication by a small integer to account for the higher harmonics) is equal to the length of the pipe in which it occurs, so would

an electron produce a light frequency in accordance with the length of its orbit around the nucleus of the atom. However natural this assumption may have seemed at the time, it became obvious the position was only tenable for the most simple systems. The reason being that the wave does not travel in ordinary space, but rather in the so-called configuration space, which has more than three dimensions if the physical system consists of more than one particle. The interpretation of the Schrödinger waves that would stand the test of time, was given by Born, who building on an idea of Bohr, Kramers and Slater, proposed to interpret the wave as a probability wave. As Heisenberg writes: "something standing in the middle between a reality and possibility".[1] The resulting theory gave surprising results in many respects. Classically, the state of a system is characterised by its momentum and position. The space of possible positions and momenta, is called the phase-space associated with that system. All other quantities are simply a function of these two variables, *i.e.* a function of its location in phase-space. In the new quantum mechanics, the observable quantities of a system, such as its energy, or momentum, are still derivable from the state of the system, but no longer by means of a simple function, but by an *operator* acting on the state of the system. The problem of finding the appropriate quantum mechanical operator $\hat{f}$ for a given classical function f, is called the quantization of that function f.[a] Quantization is by no means a trivial procedure. In fact, it has been shown that no unique answer to the problem of quantization can be given in general. Whereas clearly $f.g$, $g.f$ and $(f.g + g.f)/2$ are the same functions, the same expressions but with the functions f and g replaced by their quantized counterparts $\hat{f}$ and $\hat{g}$, represent different operators in general. Operators do not necessarily commute, *i.e.* it may very well turn out that

$$\hat{f}.\hat{g} \neq \hat{g}.\hat{f}$$

Classically, it makes no difference to ask first what the position of a system is and then its velocity or vice versa. But quantum mechanically, it does.

[a]This is not to be confused with the term *quantization* that is sometimes found in the literature on signal analysis, where it is meant to denote a conversion of a datum into a zero or a one according to a Neyman–Pearson criterion. See, for example, Ref. 2, p. 176.

3. Whose Point of View?

We owe to Galilei the realization that quantities such as speed have a relative character.[b] The relevant question with regard to the motion of a body is not "What is the speed of a body?", but rather "What is the speed of a body with respect to a certain reference frame?". Of course, the same goes for quantum mechanics. However, there is an even deeper form of dependence on the perspective of observation in quantum mechanics. To see how this works, we will present an example from analytic geometry that provides a precise analogy with quantum mechanics. If you never understood the problem of non-commuting observables in quantum mechanics, but have no problem with two-dimensional geometry, this analogy is for you.

3.1. *Description and Frame of Reference in Analytic Geometry*

The mathematical formula representing a hyperbole in the plane is presented in standard elementary textbooks in the following form:

$$x^2 - y^2 = 1 \tag{1}$$

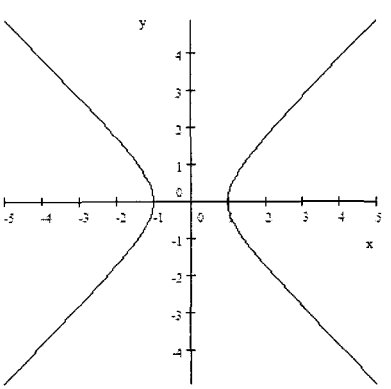

Figure 1. The graph corresponding to equation (1).

[b]It is part of physics folklore to attribute the principle of the relativity of motion to Einstein. As a matter of fact, the notion was made precise by Galilei almost 300 years before the advent of Einstein's theory of relativity.

Next take a look at the following function

$$\sqrt{2}xy = 1 \tag{2}$$

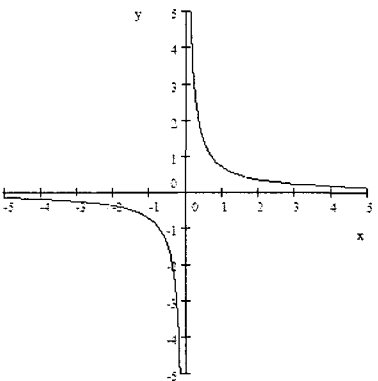

Figure 2. The graph corresponding to equation (2).

It is not obvious to determine at sight the relation between the two prescriptions (1) and (2). However, when we plot the graph it is rather obvious that (2) also represent a hyperbole. Upon inspection, we see that graph 2 is like graph 1, but turned 45 degrees anti-clockwise. The graphs make clear what the mathematical prescriptions do not: that (1) and (2) represent the same geometrical object but seen through different eyes. When we say it is the *same* geometrical object, we mean that one can be obtained from the other employing only a combination of rotation, scaling and translation. This corresponds to our experience in the real world. When an observer moves through space, he may see an object at a different angle, a different size and in a different location, but it will still be the same object. There is a general mathematical method to see if two mathematical prescriptions of a quadratic form such as (1) and (2) determine the same geometrical object. First we have to associate a 2x2 matrix with the mathematical prescription. To do so, we first write the mathematical prescription in a canonical form

$$a_{11}x^2 + 2a_{12}xy + a_{22}y^2 = 1 \tag{3}$$

The associated 2x2 matrix is a mathematical entity with 4 entries organized

as a square:

$$A = \begin{pmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{pmatrix} \tag{4}$$

So a_{11} is the coefficient of x^2, a_{22} is the coefficient of y^2, a_{12} is half the coefficient of xy and a_{21} half the coefficient of xy. This means that $a_{12} = a_{21}$. In general (that is, also for more than two free variables), the matrix of a quadratic form is *symmetric*. This means that if we interchange the rows and columns of A, (this is the so-called transpose A^T of that matrix) we get the same matrix:

$$A^T = A \tag{5}$$

Next we introduce a vector $\mathbf{x}$, which is a shorthand for the two original variables x and y, and its transpose $\mathbf{x}^T$:

$$\mathbf{x} = \begin{pmatrix} x \\ y \end{pmatrix} \text{ and } \mathbf{x}^T = (x\ y) \tag{6}$$

We are now in a position to write any (central) conic sections, *i.e.* the circle, the ellipse, the parabola and the hyperbole[c] in the quadratic form:

$$\mathbf{x}^T A \mathbf{x} = 1 \tag{7}$$

For example, when employing the rules for matrix multiplication (which we will not give here), we get

$$\mathbf{x}^T A \mathbf{x} = (x\ y) \begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} = x1x + y(-1)y = 1 \tag{8}$$

which clearly represents (1), and

$$(x\ y) \begin{pmatrix} 0 & \sqrt{2}/2 \\ \sqrt{2}/2 & 0 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} = x(\frac{\sqrt{2}}{2})y + x(\frac{\sqrt{2}}{2})y = 1 \tag{9}$$

which represents (2). Next we search for a way to identify the shape of the solutions independent of the actual form of the x's and y's. For this we diagonalize, that is transform it in such a way that only the entries a_{11} and a_{22} are different from zero. Of course, we are only allowed transformations of the matrix that leave the original geometrical object it represented intact. For an arbitrary matrix this is not possible, but for a symmetric 2x2 matrix,

[c]The same equation but with three dimensional vectors, and hence with A a 3x3 matrix, describes an even greater plurality of geometrical objects called *quadrics* for obvious reasons.

as is the case here, we can always bring it into a diagonal form by only applying a single rotation. If we applied the method of diagonalization (which we will not present here), we would find the diagonal form of the 2x2 matrix A in (9) is precisely the 2x2 matrix in (8). In this new reference frame, obtained from the old by rotation, we can easily recognise the kind of geometrical object the quadratic form presents, because it is in its standard form. There is important terminology to remember here. The axes of the new frame of reference correspond to the *eigenvectors* of the matrix A. What is an eigenvector?

For a moment, let us forget about the original functions we are studying and just look at the following matrix equation:

$$A\mathbf{x} = \mathbf{x}' \tag{10}$$

This equation tells us every vector $\mathbf{x} = (x, y)$ will, upon multiplication with the matrix A, transform into a new vector $\mathbf{x}'$. Of course it could be the case that for a certain special vector $\mathbf{x}_0$ this new vector $\mathbf{x}'_0$ is just a multiple of the old vector $\mathbf{x}_0$:

$$A\mathbf{x}_0 = \mathbf{x}'_0 = \lambda_0 \mathbf{x}_0 \tag{11}$$

If this is the case, we say $\mathbf{x}_0$ is an *eigenvector* of the matrix A and the (real or complex) number λ_0 is its associated *eigenvalue.* For example, the eigenvalues of the matrix in (8) are 1 and -1. Armed with this terminology we can make a summary of our observations.

Summary: *The quadratic form (7) obtains its most simple (diagonal) form when described in a frame of reference whose axes are the vectors (11) that are left invariant (up to multiplication by a number) by the matrix (4) associated with the quadratic form. When presented in this form, the diagonal elements of the matrix A are called the eigenvalues of A. The geometrical content of the quadratic form (7) can be determined directly from the eigenvalues of its associated matrix.*

If we have this diagonalized form, we can easily recognise whether the geometrical object is a parabola or a hyperbole or an ellipse, because the diagonal form is just the standard function we learned for these objects in high school. If the eigenvalues of the matrix in (8) are 1 and -1 (as is the case here), this means the geometrical object is a hyperbole. If both had been $+1$, it would have been a circle. If they had been two different positive numbers, it would have been an ellipse. When one of them is zero, but not both, we are dealing with a parabola.

Of course, the same results can be obtained using only elementary algebraic calculations, but the method presented here works for an arbitrary

number of dimensions, not just for two, as long as we are only presenting a quadratic form. It is important to note that it works for vectors and matrices with complex entries too, but the condition (5) of symmetry is to be replaced with the corresponding complex notion, that of a self-adjoint matrix. Think of a self-adjoint matrix as simply a matrix that can be brought into diagonal form and for which the eigenvalues are all real.[d] It turns out that an observable quantity in quantum mechanics *is* represented by a self-adjoint operator. Indeed, the same technique can be used to describe systems with a finite number of outcomes quantum mechanically, and the analogy is quite precise.

3.2. *Incompatibility in Analytic Geometry*

Suppose we have an equation such as

$$-\sqrt{2}x^3y + \sqrt{2}xy^3 + \sqrt{2}xy + x^2 - y^2 = 1 \tag{12}$$

what geometrical object would this represent? After a simple calculation, we find that it is equivalent to

$$(x^2 - y^2 - 1)(\sqrt{2}xy - 1) = 0 \tag{13}$$

What is the solution of this equation? Well, it is of the general form $AB = 0$ with $A = x^2 - y^2 - 1$ and $B = \sqrt{2}xy - 1$. This equation is satisfied when either A is zero, or B is zero. So the equation is obviously satisfied when either (1) or (2) is satisfied. The complete solution of (13) is then the set of points (x, y) that belongs to the first or the second hyperbole, and the graph of the horrible looking (13) is nothing but two graphs of (1) and (2) together. The relevant observation here, is that the basis that makes (1) diagonal (and hence takes the formula for the hyperbole in its standard form) does not make (2) diagonal, simply because the eigenvectors of the two are different. We can transform the form (12) such that either (1) is in standard form, or (2), but never the two simultaneously. We could say the two standard forms are incompatible in the sense that no single perspective can yield both simple forms at the same time. A similar situation occurs in the description of quantum systems.

[d] Technically, a self-adjoint matrix is one which is equal to its adjoint matrix. The adjoint of a matrix is defined as the complex conjugate of its transpose. This coincides with the definition given in the text.

3.3. *Description and Complementarity in Quantum Mechanics*

Suppose we have a system that we seek to describe by quantum mechanics. The theory tells us the state of a physical system is represented by a vector, say ψ, living in an abstract Hilbert space H.[e] Another fundamental postulate of quantum mechanics is that any quantity that we want to infer experimentally from that state ψ, whether it be its energy, its position or its momentum, is represented by a self-adjoint operator A. Quantum mechanics dictates furthermore that the outcome of the measurement will be one of the eigenfunctions of the operator,[f] and that the *probability* of obtaining that result is the square of the norm of the *coefficient* that goes with the eigenvector which corresponds to the outcome. Furthermore, if the matrix A represents the quantity we are interested in, and we want to know the expectation value $\langle A \rangle$ (a number representing the average physical value of A) when the system is in the state ψ, we have

$$\langle \psi | A | \psi \rangle = \langle A \rangle \tag{14}$$

We briefly indicate the meaning of the notation in (14). The quantity $\langle A \rangle$ on the right-hand side of equation (14) is just a number. We can always rescale the matrix so that the left-hand side of the equation equals one without altering the essential geometrical content.[g] The so-called bra vector $\langle \psi |$ in (14) is the dual of its corresponding ket vector $|\psi\rangle$, just in the same way as $\mathbf{x}^T$ in (7) represents the dual of $\mathbf{x}$ for finite spaces. These are the fundamental postulates of simple, non-composite, non-relativistic quantum systems and to understand the geometrical meaning of the words in these postulates, we only need the analogy with analytic geometry. Indeed, Eq. (14) may look cumbersome to the reader who is unfamiliar with the *bra-ket* notation, but for observation of systems with only a finite number of outcomes, it is formally equivalent to the quadratic form (7):

$$\mathbf{x}^T A \mathbf{x} = 1$$

[e] A Hilbert space is a generalisation of the well-known vector space, in that it allows for infinite dimensions and is equipped with an inner product.

[f] If the Hilbert space of the system is infinite dimensional, not all operators have eigenfunctions which are vectors in H (eigenvectors). None-the-less, the interpretation of a measurement of A is the same.

[g] Of course, this changes the expectation value itself, but this is of no consequence. One can also change the value of any quantity by scaling the appropriate dimensions, without in any way changing the physics of the phenomenon. Our rescaling only serves the purpose of demonstrating the essential equivalence between (14) and (7).

According to the former section on analytic geometry, we already know how to find the eigenvectors and corresponding eigenvalues: we simply have to diagonalise the self-adjoint matrix that corresponds to that observable quantity. Just as in the case of analytic geometry, the matrix P corresponding to a given operator, say its momentum $\hat{p}$, yields its "secrets" easily in a description that fixes the axes of reference to the eigenvectors of that same matrix: in its diagonal form, the probability of an outcome is simply the square of the corresponding diagonal element. Now we ask whether the same is true for the position of the system. Well of course, it is an axiom of quantum mechanics![h] Simply calculate the eigenvectors of the matrix Q that corresponds to the position operator $\hat{q}$ of a system, and draw your frame of reference there. Look again at what you have got, and you will only find diagonal entries from which you can immediately read the probability of obtaining a certain result. Now we may wonder: is the new frame of reference that diagonalizes Q, also a frame of reference that diagonalizes P? The answer depends on the relation between P and Q. It is a mathematical theorem that if and only if P and Q (or their associated operators $\hat{p}$ and $\hat{q}$) *commute*, there exists a common frame of reference in which both are diagonal. But P and Q do *not* commute in quantum mechanics, and hence there is a problem with the simultaneous extraction of position and momentum information for a quantum mechanical system. Indeed, in quantum mechanics, we have the commutator relation:

$$\hat{q}\,\hat{p} - \hat{p}\,\hat{q} = \frac{ih}{2\pi}\hat{I} \tag{15}$$

in which h is the famous constant of Planck and $\hat{I}$ the identity operator which is clearly different from zero.[i] So we know from this equation (whatever the value at the right hand side was) that there does not exist a common frame of reference such that both P and Q are diagonal. Bohr introduced the notion of complementarity to describe this phenomenon. Q and P are like the inside and outside view of a house: both yield valuable information as to what a house is, but the better one can see the inside,

[h] Mathematically speaking, we are making an unwarranted simplification. The operators coresponding to Q and P live in an infinite dimensional space, for which we have to use the spectral theorem, rather than speak about eigenvalues and eigenvectors. The reader is asked to keep this in mind and understand that we are really talking about the infinite dimensional equivalents of the terms we employ here.

[i] It is known since the advent of quantum mechanics that no finite matrices P and Q can satisfy (15), once more indicating the necessity of upgrading the traditional vector space of analytic geometry and finitary quantum mechanics to the Hilbert space.

the more one is neglecting the outside. Bohr coined the phrase that P and Q are *complementary* descriptions of the same system. The simultaneous extraction of P and Q information is hence limited by the uncertainty principle of Heisenberg, to which we will come back later. Many of the early gedanken experiments in the early history of quantum mechanics, and from the historic Solvay conference in 1927 in particular, can serve (and indeed were meant to serve) as an illustration of this principle.[3]

4. Signal Analysis

There is another field of scientific inquiry that has had to learn to deal with incompatible perspectives of the nature of the phenomenon; the field of signal analysis. The field of signal analysis is concerned with the extraction of information from a time-varying quantity which is called the signal. The signal can originate from very different sources. It can be electromagnetic, acoustic, optical or mechanical. It can contain various quantities and qualities of information. Needless to say, how to extract information depends on the way you look at things. Let us take an example. Suppose a sound technician is responsible for the music played by a live band at a party with a strict beginning and end in time and a strict limit to the amount of decibels that may be produced so that no neighbors are disturbed by the party. To make sure he starts and ends at the right moment, he checks, and if necessary adjusts his watch beforehand. At the moment the band starts, he lets the volume rise to an audible level that is still under the prescribed decibel limit and stops right before the announced end of the party. Take the music coming out of the speakers as the signal. The mathematical representation of this music as a time-varying quantity will allow him to do all that he needs. Given just this time-varying quantity, he could even have been in a remote place where he cannot hear the music and still perform the task he was given with a remote control. He merely needs to check that the signal starts after the prescribed time, stops before the prescribed ending, and make sure it does not exceed the given maximum volume. Suppose now however that the live music produces a feedback effect. The volume grows and an insistent, painful whistling tone is heard. If the sound technician is there, he will correct the problem, but if he is in a remote location with his remote control, he will simply lower the volume somewhat and assume everything is alright. The people attending the party will probably judge differently. The time varying quantity does not easily allow for the reading of frequency related information. If however,

the sound technician made use of a spectral analyzer, he would have been able to correct even that problem remotely. The spectral analyzer performs a transformation of the signal. Rather than displaying the intensity of the signal in time, it yields the intensity of the various frequency bands heard within a given time interval. The feedback will be visible as a rapid and lasting rise of a small frequency band. Technically, the transform involved is called a short-time Fourier transform of the signal. It turns out that the operator corresponding to the Fourier transform does not commute with the operator that yields the intensity at every instant. So we see that the situation is quite similar to quantum mechanics from this point of view. In both situations, we are looking for an appropriate perspective to describe or extract the information, by transforming the system to a frame of reference that is constructed on the basis of the eigenvectors of the quantity that we seek to describe.[j]

4.1. *Quantum Probability and Signal Analysis*

The introduction of many of the definitions and methods used in signal analysis originated from similar developments in quantum mechanics. In a sense this is a curious historical fact, as it was originally accepted that quantum physics presents a fundamentally different theory than classical physics and the physics of signals is essentially classical. As physicists like to point out, quantum mechanics is inherently indeterministic, and signals are essentially deterministic. Whereas quantum physics describes the fundamental interactions in nature and is governed by Planck's constant, signals are continuous in nature and no constant governs their behavior. Yet in the literature on signal analysis,[5,6] we find the names of quantum physicists like Weyl (ordered operator algebra), Wigner (quasi-distribution), Heisenberg (uncertainty boxes) and Cohen (bilinear class). In 1946 Gabor, the inventor of the hologram and the atomic representations of signals, introduced the Heisenberg inequality in signal analysis.[7] Only two years later, Ville,[8] was to introduce a time–frequency distribution as a signal analytic tool that is formally equivalent to Wigner's distribution in quantum mechanics.[9] The similarities between the two is of such extent, that apparently some con-

[j] Again we reach the limit of the validity of our analogy. We should have said that it is impossible to construct spectral families for the operators simultaneously. In fact, to do the job properly, we need to decompose the operators in terms of so-called positive operator valued measures rather than positive valued measures (spectral families). For the interested reader, we refer to Ref. 4.

cepts were invented independently in both subjects without reference to its parallel in the other subject. Although Ville constantly evokes language borrowed from quantum mechanics, the Ville distribution itself was originally given without reference to Wigner and the same occurred with the Rihaczek distribution,[10] that was historically preceded by the Margenau and Hill distribution in 1961.[5] Sometimes researchers in quantum mechanics would cross the border to publish results useful to the signal analyst. We mention Cohen's work,[11] on bilinear and completely positive phase space distributions and the squeezed states of Caves,[12] and Man´ko,[13] that have found application in the construction of signals that are used in radar technology. To give the reader a taste of the extent of the overlap between the two fields, we sum up the main similarities.[k] Both signals and quantum states are identified with vectors in a Hilbert space. Both see as operational quantities the modulus squared of these elements, which in signal analysis is called the energy density of the signal and in quantum mechanics the probability density of the entity. Both utilize the Fourier transform as the relationship between two of the most important operational quantities, time and frequency in signal analysis and position and momentum in quantum mechanics. As a consequence, both use the Heisenberg inequality and frequently employ non-commuting operators for observable quantities. Both fields employ the Wigner quasi-distribution as a phase space quasi-density.

4.2. *The Fourier Paradigm*

Basic detection and error estimates can be given just from examining the major repetitive components of a signal. If major components in the signal tend to have a repetitive nature, one can average the signal over a large number of cycles. This technique is called time synchronous averaging and diminishes the noise content of the signal. Another very popular technique to acquire primitive frequency-related information of a signal $\phi(t)$, is to take the auto-correlation function, which is the average of the product $\phi(t)\phi(\tau + t)$. However, if the signal is too complex, these methods have their limitations in providing frequency related information. The cure, which marked the birth of modern mathematical signal analysis, dates back to Joseph Fourier's (1768–1830) investigations into the properties of heat transfer in the early 1800's.[14] Fourier conjectured that an arbitrary periodic function, even with discontinuities, could be expressed by an infinite sum of

[k]The reader who is not familiar with either subject is advised not to take the terminology too seriously and just regard this list as a witness to the similarities.

pure harmonic terms. The idea was ridiculed among many great scholars, but a large portion of mathematical analysis in the 19th and 20th centuries was dedicated to making the statements of Fourier precise and the Fourier transformation eventually became a tool of utmost importance in signal analysis, quantum physics and the theory of partial differential equations. In words, the Fourier theorem states that the sum of an infinite number of appropriate trigonometric functions, can be made to converge to any periodic function. Take a signal with period $2L$

$$\phi(t) = \phi(t + n2L), n = 1, 2, 3, \ldots$$

Calculate the following quantities with $\omega = \frac{\pi}{L}$:

$$a_0 = \frac{1}{L}\int_{-L}^{L} \phi(t)dt$$

$$a_n = \frac{1}{L}\int_{-L}^{L} \phi(t)\cos(n\omega t)dt$$

$$b_n = \frac{1}{L}\int_{-L}^{L} \phi(t)\sin(n\omega t)dt$$

Knowledge of the signal $\phi(t)$ obviously implies knowledge of the numbers a_n and b_n, provided the integrals exist. But Fourier's theorem states the far less obvious fact that, under mild assumptions, the converse also holds

$$\phi(t) = a_0/2 + \sum_{n=1}^{+\infty} a_n \cos(n\omega t) + b_n \sin(n\omega t)$$

Knowledge of the numbers a_n and b_n implies complete knowledge of $\phi(t)$. The Fourier expansion is such a valuable tool because of its ability to decompose any periodic function (*e.g.* machine vibrations, sounds, heat cycles,...) by means of sines and cosines. As the reader may now appreciate, one can regard the sines and cosines as the eigenfunctions of the frequency operator. They form the orthonormal basis functions, the axes of the new frame of reference, and the coefficients of these orthonormal basis functions represent the contribution of the sine and cosine components in the signal. This allows the signal to be analyzed in terms of its frequency components. Rather than studying signals in their time domain, one could now study the characteristic frequencies of the phenomenon. A serious draw-back of the method is that only periodic signals can be represented. The Fourier paradigm was extended to cover non-periodic functions by means of the so called Fourier transform. To include non-periodic functions, we take the

limiting case of the Fourier series when the period of the function goes to infinity. When we do this, we obtain the following formulas:

$$\Phi(\nu) = \int_{-\infty}^{+\infty} \phi(t) \exp(-2\pi i \nu t) dt \tag{16}$$
$$\phi(t) = \int_{-\infty}^{+\infty} \Phi(\nu) \exp(2\pi i \nu t) d\nu$$

We call $\Phi(\nu)$ the Fourier transform of $\phi(t)$, often written as $\mathcal{F}[\phi(t)] = \Phi(\nu)$, and $\phi(t)$ is the inverse Fourier transform of $\Phi(\nu)$ written as $\mathcal{F}^{-1}[\Phi(\nu)] = \phi(t)$. The couple of functions $\{\phi(t), \Phi(\nu)\}$ is called a Fourier pair. The drawback of this representation, as one can judge from the boundaries of the integral, is that the signal has to be known at all possible times, something that is never the case in applications. Of course, in an idealized situation, such as a quasi-monochromatic or a steady state description, the method yields true properties of the signal in question. But transitional regimes of signals are simply beyond the scope of this method. Even with this limitation, the importance of the consequences of (16) can hardly be overestimated. It was a source of inspiration to most advanced methods of transformation that eventually led to the field of wavelets, which have found wide spread use in almost all practical branches of contemporary applied science.[6] Let us therefore have a brief look at some of the properties of the Fourier pair (16).

4.3. *Properties of Fourier Pairs*

We call the region were a function does not vanish (*i.e.* is not equal to zero), the *support* of that function. If the support of $\phi(t)$ is of finite width, then the width of the support of $\Phi(\nu)$ is infinite and *vice versa*. But even with unbounded support (*i.e.* when the support has infinite extension), a reciprocal relationship exists between $\phi(t)$ and $\Phi(\nu)$. To see this, assume the signal is normalized ($\int_{-\infty}^{+\infty} |\phi(t)|^2 dt = 1$) and that the center of gravity of both $\phi(t)$ and $\Phi(\nu)$ vanishes:

$$\int_{-\infty}^{+\infty} t|\phi(t)|^2 dt = \int_{-\infty}^{+\infty} \nu|\Phi(\nu)|^2 d\nu = 0$$

This can always be realized by an appropriate choice of the axes. We define the following quantities:

$$\Delta t = \int_{-\infty}^{+\infty} t^2 |\phi(t)|^2 dt$$
$$\Delta \nu = \int_{-\infty}^{+\infty} \nu^2 |\Phi(\nu)|^2 dt$$

If $\phi(t)$ decays fast enough such that $t|\phi(t)|^2$ vanishes at infinity, the following relation follows from the Cauchy–Schwartz inequality:

$$\Delta t.\Delta \nu \geq \frac{1}{4\pi}$$

This relation is known in the literature on signal-analysis as the Heisenberg–Gabor uncertainty principle. The name is due to the fact that Gabor, an electrical engineer working on communication theory, discovered the relevance of this relationship to signal-analysis in 1946, about two decades after Heisenberg — one of the founding fathers of quantum physics — formulated the principle on physical grounds.[7] Weyl showed it to be a mathematical consequence of the fact that the corresponding operators are a Fourier pair.[15] And we see that indeed, the frequency and temporal descriptions of a signal yield complementary views of its information content. It should therefore come as no surprise that their respective operators do not commute. Instead of $\hat{t}\ \hat{\nu} = \hat{\nu}\ \hat{t}$, we have:

$$\hat{t}\ \hat{\nu} - \hat{\nu}\ \hat{t} = \frac{i}{2\pi}\hat{I}$$

Similar equations exist for the time and scale operators that are found in the literature on wavelets. This is to be compared with the equivalent relation for position and momentum in quantum mechanics (15):

$$\hat{q}\ \hat{p} - \hat{p}\ \hat{q} = \frac{ih}{2\pi}\hat{I}$$

where h denotes Planck's constant. This latter relation implies the well-known Heisenberg uncertainty relation:

$$\Delta p.\Delta q \geq \frac{h}{4\pi}$$

We see that, apart from Planck's constant, the commutator and uncertainty relations have the same mathematical content when we apply the following

substitution:

$$\hat{p} \rightsquigarrow \hat{\nu}$$
$$\hat{q} \rightsquigarrow \hat{t}$$
$$h \rightsquigarrow 1$$

With this basic vocabulary, it is easy to extend the list to include many more examples of corresponding quantities. We refer the interested reader to Ref. 11, p. 197.

5. Concluding Remarks: The Necessity of Combining Mutually Incompatible Perspectives

We have seen that there are striking mathematical similarities between quantum mechanics and signal analysis. Historically, these mathematical analogies are the roots of the ongoing cross-fertilization between the two fields. Moreover, when we encounter a discussion in the literature that attempts to answer *why* this cross-fertilization has taken place, the similarity between the mathematics is invariably seen as the main source. There is no doubt that this analysis of the situation is correct, but it leaves the question *why* the similarities are there in the first place unanswered.[1] Of course, the analogies could be purely coincidental. For example, both fields emerged from studies in the physics of heat. Quantum physics originated from the study of black body radiation, and signal analysis was born with Fourier's study of heat processes. We believe this is indeed coincidental, as neither quantum physics, nor signal analysis deals primarily with the problems of heat transfer or radiation. On the other hand we believe the nature and origin of the similarities we have described is not coincidental, and we have given a metaphor from analytic geometry to support that thesis. The origin of the analogy that we identified from our metaphor is that, even though the state of a system (or signal) can be fully known, the extraction of measurable quantities (relevant information of signal) from a state requires taking a point of view, and not all points of view are compatible with one another. So we conjecture that the reason for the mathematical parallels is that both theories inherently contain a theory of observation.

[1]It is interesting to note that detailed similarities can be explained as a result of the irreducible representations of the Poincaré group. These representations are the same for both the massive and zero mass cases, so they apply to photons, which are often the carriers of signals and massive quanta alike. The Lie algebra is the same for both and that gives rise to the uncertainty relations. For more details, see Ref. 4.

Complementarity arises in both fields because in some parts of reality there are mutually incompatible, but equally valid, perspectives of the same object. One cannot see the inside and outside of a house at the same time. A natural question to consider is then: When do we know when we have a sufficient number of views so that we are certain that we have seen "the full house"? The metaphor from analytic geometry regards "perspective" as the equivalent of "frame of reference". We have elaborated that the frame constructed from the eigenvectors of the operator that represents the kind of information we are interested in yields the most simple description. So our question can now be translated as follows: What set of operators do we need to make sure that we have seen every aspect of the house? The most direct way of tackling that question, relies on Prugovečki's concept of *informational completeness* within quantum mechanics.[16] A set of operators is called informationally complete if there is only one state compatible with the probabilities obtained from it. This means that for an informationally complete set of measurements, the state can be uniquely derived from the expectation values of these measurements. Moreover, the expectation value of *any* operator (*i.e.* any point of view) can be calculated as a simple average of functions of the outcome probabilities of the informationally complete set.

Now one can raise the question whether the whole phenomenon of complementarity cannot be avoided. If we take a sufficient number of compatible perspectives (*i.e.* commuting operators) can we obtain an informationally complete set? The answer is *no*. It was shown by Busch and Lahti that no set of commuting observables is informationally complete![17] Complementarity is here to stay. This was intuitively accepted by most researchers in both fields, even though the result of Busch and Lahti is not widely known among quantum physicists, and largely unknown among signal analysts. Nevertheless, it is common knowledge among researchers in the field of theoretical signal analysis, that analyzing a signal in terms of the distribution in the non-commuting observables that are relevant, provides a much more revealing picture in many cases than, for example, the spectrogram or the signal together with its Fourier transform. One can show the spectrogram (and most other representations) to be informationally incomplete and the Wigner–Ville distribution to be informationally complete.[4]

If our analysis makes sense, we should find that if one restricts the observations in quantum physics to the case of a single observable, that is to the results of essentially one experimental set-up, the results of the quantum

probabilistic scheme can be reproduced by a classical probability model. It turns out that this is true. Hence the power of quantum statistical methods over classical probabilistic analysis is perhaps most obvious when dealing with expectation values and correlations of observables that do not commute. It is in this respect that quantum-like representations, be it a phase space representation or a density matrix, provide us with a statistically complete language for the incorporation of data from disjoint or incompatible measurements into a single state of the entity under observation. As a consequence, the conventional paradigm that quantum probability pertains to the micro-world and classical (Kolmogorovian) probability pertains to the macro-world is no longer tenable from this point of view. This is not because micro-physical principles of the entities under observation are at work, but because the relation between the possible ways in which we look at these phenomena is structurally isomorphic. But mutually incompatible perspectives are to be found in many areas that are of scientific interest. What about the social implications of interactions between cultures with incompatible value systems? What about the well-known graphical figures that yield one gestalt or another (but never both at the same time) depending on how they are looked at? A sentence may be deemed innocent within one context, but disturbing in another. A single note can make one chord cheerful and another chord sad. One cannot hope that investigations in these areas will yield precise quantitative statements any time soon in the same way as we have in engineering or physics. Nevertheless, the lesson that it is only together that these incompatible perspectives give an informationally complete picture may well be still valid.

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