CONSTRUCTIVE SYSTEMS SCIENCE - THE ONLY REMAINING ALTERNATIVE?

A CONTRIBUTION
TO
SCIENCE AND HUMAN EPISTEMOLOGY

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Abstract

The opposition between the realists and the anti-realists is as old as Western science. The question as to whether the “furniture of the world” we call the “things” is to be considered real or not has consistently been at the forefront in the debates about science and philosophy. This urgent interest is motivated by the close connection to another question – namely that of scientific objectivity - an issue that seldom receives proper treatment. Objectivity has rather been taken for granted in the traditional Newtonian paradigm with its well-known slogan: The detached observer is the objective one and the rational mind of clarity.

It was impossible to continue with this dictum, which is responsible for the cleft between the natural and social sciences and still presents a ban on human feelings in scientific endeavours, after the findings of quantum mechanics at the beginning of the 20th century. However the penetrating power of this important insight has been astonishingly weak and with the emergence of computer science in the middle of the century, Newtonian science’s self-assumed status of objectivity has been apprehended as both very doubtful and a severe hindrance in other areas outside the quantum domain of scientific activity. The efforts of computer modelling and simulation analysis revealed a pronounced observer-dependency regarding investigation.

For these reasons this thesis will scrutinize the activity of science and the art of modelling – proposing the use of a 2-step model of modelling (metamodel) to clarify and emphasize the involvement of the observer in the process of observation. This approach reveals that the object-oriented approach (OOA), which has been the prevailing one since the dawn of Western science and is one of the basic tenets of the Newtonian paradigm, makes science unable to describe its objects of discourse in an observer-independent manner. Such a science is at risk to be considered inconsistent, incomplete and non-objective and for that reason unfit for consensual scientific use.

The main claim of this thesis is that the object-oriented approach is responsible for the genesis of Cartesian dualism and other inconsistencies, which are met in present day science. Such a claim is not novel however, but I will argue that when science is dressed up as the Subject-oriented Approach to Knowledge (SOA) a long row of embarrassing and bewildering situations encountered in classical human conceptualisation will vanish – in a way that, as far as I know, has never been explicitly explained before. This approach also promises a unification of the different disciplines of sciences so that e.g. the social sciences can be treated on an equal footing with the natural sciences – and thus this embarrassing gulf of human knowledge can be removed. This is a profound shift of paradigm in science and the re-orientation of human thinking required is both considerable and time-consuming.

For this reason this thesis is not a systematic presentation of the SOA, but rather tries, in Part 1, to pave the way for an understanding of this approach by an introductory discussion about the means and scope of science and the essential role of symbolic modelling in this endeavour – and in particular the way these activities will be influenced by the anticipated change of paradigm. Some historical aspects of this particular SOA are also given as a background and this section is completed by a brief survey of the modern trends in scientific modelling.

Part 2 is collection of papers dealing with the principles of modelling and simulation, and, rather more importantly, a sequence of papers reflecting how the ideas of the SOA have developed throughout the years due to the inconsistencies met with in these and adjacent areas. To my mind they prove - beyond the point of any consensual doubt – that the realist’s position in science cannot be defended any longer and that the “things of the world” by the scientific community must be considered merely private allusions1.

More important however is the insight that the Newtonian paradigm is unable to produce an observer-independent description of this world with its conceived things and the only way out of this embarrassing dilemma seems to be the acceptance of the SOA – with its hitherto strictly banned feature of subjectivity. Using this approach, we claim, science can be given a consensual and consistent foundation – and the price to pay is the loss of scientific ontology. As already pointed out this thesis merely hints at the new path to take – instead concentrating on the reasons for the impending demise of scientific realism and need of a constructive systems science.

1 See Appendix A
Acknowledgements

I started as a road construction engineer at Skanska and if it were not for a hardy local manager at Edsberg I would never have embarked upon a scientific career. My first academic career started by studying physics at Stockholm University for Professor Albin Lagerquist and his colleagues in the field of emission spectroscopy that gave me an inspiring start. The colourful rainbow was the dominant subject matter when I passed my Masters degree in physics in 1956 at the University of Stockholm. This somewhat involved phenomenon was the favourite subject of my examiner Professor Lagerquist and this illusory reality or real illusion really caught my mind – and has since become the paradigm of illusory existence. The very question “do rainbows exist?” came to highlight the doubts I had about physical existence. I also remember when I looked at stars one starlit night in November and was filled with a feeling of immense humbleness and reverence and struck by the distress that I could never find out where the universe ends – and wondered why I could not find that out. But now I know.

My best friend and fellow student Erland Wennerberg and the two physicists Michelson/Morley were profound sources of inspiration. After my Master’s degree Dr. Magnus Brenner at Svenska Aluminium-kompaniet in 1964 gave me free rein introducing the first computer assisted quantometer in Sweden and thus my interest in digital computers was aroused. The late technical manager Hugo Skantze became as a father to me and appointed me in 1968 to be head of one of the first research projects on Computer Assisted Process Control in Sweden. In cooperation with the Department of Control Engineering at Chalmers University of Technology led by Professor Birger Quarnström and their project leader Dr. Krister Gerdin we set out to control the only aluminium smelter of Sweden. Around me and the research centre at Sundsvall called the “Landgrenska villan” a group of inspiring colleges gathered and we were free to follow our intuitions – and meeting with control theory and its intriguing feedback phenomena, the step to Norbert Wiener and the interest in cybernetics was very natural.

The people mentioned here have without doubt had been extremely influential in my scientific training and thinking. Encouraged by their insights and support I now realise that, even at that time, I had fully developed the sceptical attitude that has urged me not to take anything for granted – not even the fundamentals of Western science. This sometimes toilsome attitude has been my guiding star since and is probably the prime reason for the direction of my present research.

My second academic career started when Lennart Hjul asked me to join him to lay the foundation stone of what was to become Mid-Sweden University in 1972 - the year of the birth of my son Tommy. Two years later my daughter Sara arrived and these two have been my true inspiration and very reason that I stayed as a lecturer mainly at Mid-Sweden University for many years. No other people have taught me more about life and myself than those two wonderful beings. I came to teach mathematics, physics, computer science, systems engineering, systems development both at the engineering departments - and between economists and social scientist almost by accident. However this situation laid a solid foundation for the cross-disciplinary approaches to come. In parallel I was still engaged in several industrial research projects mainly concerning computer simulation.

In 1989 I met with Dr. Mats B. Klint who urged me to complete my doctoral thesis that, for several reasons, was interrupted in the 1970s. He inspired me to launch my third academic career in a cross-disciplinary effort aimed at injecting some computer science into the industrial business marketing. In this project I met with a totally different research tradition - very much anchored in hermeneutics, phenomenology and the Continental traditions of philosophy. As time went by my advisors came and went and never gave me much support – perhaps even their eventual advice was totally in vain since I very soon wanted to find out what was wrong with scientific realism. Scientific modelling had always been a great interest of mine – and especially computer simulation – an interest, which at that time, was readily broadened into human conceptualisation – in particular cognitive science and consciousness studies – two disciplines that had also encountered insurmountable difficulties with the classical Newtonian approach to knowledge. The modern cognitive sciences insist that human cognition is theory-laden, a claim that cannot possibly be included in the prevailing Newtonian paradigm and it is well known that human consciousness cannot even be studied in this paradigm. Both discipline are badly in need of a definition of science from the first person perspective.
After a conference in Riga I conferred with Dr. Alwyn Scott who shared my interest in cybernetics and he – perhaps unknowingly – provided the missing links for the formulation of the SOA. He engaged me as a commentator on his course “Modern Science and Mind” and he engaged in lively discussions. I am in debt to him for many of my solutions to the consciousness puzzle. Thanks to my present advisor Professor Love Ekenberg who so firmly and boldly forced me to finish my doctoral thesis and without whose help this thesis would never have come true.

During the 12 years of my third career – I have been a scientific freebooter embarking on a toilsome cross-disciplinary approach that very much lacks a legal domicile of its own – but in 1994 I met with a tiny group celebrating the ideas of Norbert Wiener, trying to apply the idea of cybernetics to the social domain. This group – the Research Committee on Sociocybernetics RC 51 under the International Sociological Association – has during the years given me great support and a neat social network of contacts. I owe a lot to especially Dr. Bernard Scott and Dr. Bernd Hornung who have both come out with precise comments, valuable advice as well as having participated in endless discussions during the years. I am also deeply in debt to Ms Fiona Wait who has been most helpful turning my Swenglish into English.
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Thesis Overview:

Introduction and survey

1. Science and Modelling
   1.1 What is the Problem?
   1.2 The Subject-Oriented View in Retrospect.
   1.3 What is Science?
   1.4 What Do We Mean by ”Real”?

2. Supporting Papers
   2.1 Survey of Collected Papers
   2.2 Conclusions and Future Research
   2.3 Collected Papers
0. Introduction and Survey.

Modelling has been and is a central endeavour in science and enterprise, a role that will be even more central in the future – especially in the light of the spectacular achievements in the field of modern information technology. The modelling concept, brought to such a successful use within the natural sciences and technology, is not only a concern of these disciplines. When we also consider the spoken natural languages to be modelling frameworks as well, we come to see that modelling is the only means of human communication – both on the private and the collective plane.

Within the humanities - such subjects as philosophy, literature, and the fine arts, that are concerned with man and his culture as distinguished from the sciences – modelling is also central but here we clearly recognize that modelling sometimes has very little to do with the truthful representation of the objects of some presumed reality. Here the structure of the source is of subordinate importance and the models presented rather reflect (or communicate) the feelings and intuitions of their creators – perhaps most famously exemplified by Picasso’s painting “Guernica.”

However the model’s power of communication is not diminished by that at all – on the contrary – the red colour of the painting that strikingly captures the anger of its creator, for instance – makes use of an analogy that is clearly understood by most human beings, and so displays the presence of a feeling that is otherwise very difficult to capture.

Scientific activity and modelling in particular, in contrast, are supposed to stay above the influence of such subjective elements – because scientific knowledge is objective knowledge - this is at least the very claim of modern science. However science has never explained the essence of such a claim on knowledge and even if such is possible – as a matter of fact it has very much failed to explain in what way knowledge relates to the presumed object (source) of this knowledge. On the contrary, classical metaphysics and scientific ontology, tacitly assume that there is an object – called Nature – which by means of a process of mapping influences the observer’s mind – and also in some mysterious way allows the trained scientific observer to stay outside his/her role of human being in making these observations. The scientific mind that is supposed to be the mind of clarity in that view comes out as a very confused one – and we will discover this confusion is deeply buried in the prevailing realist’s doctrine.

This thesis tackles the fundamentals of this doctrine – which lie in the very core of the Newtonian paradigm – not to say the very paradigm of being human. In its core lies the idea of a pre-given Nature that provides the knowledge and which is the very basis that human thinking builds on. This is the idea of a positive science – the science of the real - a science built on observation and experimentation a view that since the Milesian School has had a good foothold throughout Western knowledge history. However this view has, over the years, met strong opponents claiming Nature and Society to be result of the manipulations of its divine creator(s) or some other causes hidden to human observation. The idea of hidden causes is very much alive in today’s science especially in modern attempts to rescue the wavering realism, but the atheist, on the other hand, has today succeeded in totally removing the divine creator from the picture.

This thesis does the opposite - it removes Nature. Not from human conceptualisation however, but from human knowledge as a common singular phenomenon. That is, in this view Nature cannot be regarded a phenomenon separated from the human mind and knowledge any longer – and then detached observation is neither consistent nor complete. Unfortunately this situation violates one of the fundamental principles of classical Western science.

The claim here is that every being, not only humans, carries its own private universe in its mind – its priverse, as the useful instrument guiding its own actions – both physical and mental. We can think (contemplate) of this priverse, indulge in daydreams (simulation) and allow ourselves to guide our living by making predictions of what is to come. We do this sometimes successfully – which in a sense certifies the conception of a Nature. However “N-a-t-u-r-e” is all there is to it – a name of a subdomain belonging to a conceptual domain of knowledge – an address pointing at a conceptual boundary enclosing a region of our knowledge. We can communicate about this knowledge domain called “Nature” - using a set of models; and the very “things” we apprehend as belonging to this “Nature” domain; by using conceptual models (or schemata) the instances of which we tie together in a network of interactions. We can also communicate about another more “evident inner world” – our ideas and imaginations in the same manner. However the very moment we try to assign a detached existence or pre-given properties to the “Nature” domain, we are once more caught in the classical dualistic thinking as advocated by the Newtonian paradigm. As a contrast
we would never ever think of the other part of our knowledge domain – the innate ideas – as neither pre-
given nor equipped with properties.

The main claim of this thesis is that the confusion mentioned is responsible for the genesis of
Cartesian dualism and some other inconsistencies met with in today’s science. Such a claim is not novel
however, but dressed up as the Subject-oriented Approach to Knowledge\(^1\) (SOA) a long row of embarrassing
and bewildering situations met with in classical human conceptualisation will vanish – in a way that, as far as
I know, has never been explicitly explained before. This approach also promises a unification of the different
disciplines of sciences so that e.g. the social sciences can be treated on an equal footing with the natural
sciences – and thus the embarrassing gulf of human knowledge can be removed. This is a profound shift of
paradigm in science and the re-orientation of human thinking required is considerable and time-consuming.

For that reason this thesis is no systematic presentation of the SOA, but Part 1 rather tries to pave the way
for an understanding of this approach by an introductory discussion about the means and scope of science
and the essential role of symbolic modelling in this endeavour – and in particular the way these activities will
be influenced by the anticipated change of paradigm. Some historical aspects of this particular approach are
also given as a background and this part is finished by a brief survey of the modern trends in scientific
modelling.

Part 2 is a collection of papers dealing with the principles of modelling and simulation, and, rather
more importantly, a sequence of papers reflecting how the ideas of the SOA have developed throughout the
years due to the inconsistencies met with in these two areas. To my mind they prove - beyond the
point of any consensual doubt – that the realist’s position in science cannot be defended any longer – and the
presumed things of the world (or the “furniture of reality”) to be unknowable in principle – are pure
allusions. This idea is not new but the strength of the Newtonian paradigm has for a long time and for several
reasons outdone its penetrative power to the detriment of human understanding. However the advent of
quantum physics and the renewed interest in human consciousness and the many achievements of the 20th
century have paved the way for a necessary and revolutionary shift of the very paradigm of science – and the
growth of this conviction of mine is what this thesis is about. Since the SOA makes science a conventional
activity based on consensual social decisions (that very well can be compiled under the name of a paradigm),
it is also a strong argument in favour of the assertions put forward by T.S. Kuhn (1962) in his significant
book “The Structure of Scientific Revolutions.” Collected Paper No 6 of this thesis particularly brings
forward the inadequacy of the Newtonian paradigm and its supporting realist’s doctrine foreboding the
demise of realist’s approach to scientific thinking.

PART 1. SCIENCE AND MODELLING

We start by giving the background to the assiduous problem that has tortured human knowledge since
the dawn of Western science – namely the quest for the essence of the world and thereafter we briefly
present the object-oriented and subject-oriented approaches. We briefly survey the philosophical ideas
behind human observation and knowledge acquisition – the object-oriented approach (OOA) - and the
traditional means of knowledge production in science. The realist’s doctrine as part of the Newtonian
paradigm is supportive to the OOA that regards knowledge mainly as a process of discovery. An elaborate
account of this approach and its foundations can be found, for instance, in Bunge (1977).
The subject-oriented approach (SOA), that has hitherto had few defenders, regards knowledge mainly as the
result of human construction. Here, the object of observation is not in the centre of the investigation, but
rather the knowing (and observing) subject. The reason that the SOA is rarely used is the prevailing ban put
on scientific subjectivism. Berkeley (1710), Mach (1906) and Husserl (1917) are the foremost contenders of
scientific subjectivism – see Section 1.2 – but it is already worth noting here, that the SOA has not yet been
subject to a clear-cut use even if Carnap’s attempt (1928) came very close.

Part 1 is further subdivided into 4 sections:

\(^1\) A clear-cut use of the subject-oriented approach ends up in the specific monism called idealism – or Platonic
idealism - which maintains that all the objects of science are mental in principle. The subject-oriented approach is
however more a fundamental point of epistemological take-off - hence the choice of this name.
1.1 What is the problem? – Gives the background to how I came to put the conceptual foundations of Western science into question – and what findings gave me the courage to pursue the quest for a useful epistemology.

1.2 The subjectivist’s view – a historical retrospect - gives the historical background of the subjective approaches that has every now and then come out from the shade of the dominant realist’s approaches that have hitherto dominated Western science. Thereafter we discuss the 20th century: Logical positivism, the Received View and its successors and the impact of computer methodologies on the modern scientific modelling.

1.3 What is science? – Asks what are the criteria we use to discern science from other human forms of activity and in particular the question what are the objects of science – and what is the use of such objects.

1.4 What do we mean by “real”? - In this section we connect to the real/unreal dichotomy that is so fundamental to the methodology of scientific realism and examine how this dichotomy relates to Nature and human consciousness. We find that here scientific modelling plays an important role and is an activity that, according to the realist’s doctrine, is given some characteristic features. In particular the experimental methodology of modern science is analysed – but not using the traditional one-step process of modelling - but rather by means of a two-step perception/explication model that most importantly highlights the central role of the sign in human conceptualisation. We show that the sign is a two-fold phenomenon that as well as its (token) appearance also “stands for something else”, and this “else” is normally absent to the modeller. We show that the extreme consequence of this absence is that the sturdiness of “classical reality” dissolves in a fuzziness that cannot possibly be reconstructed. This insight makes classical dualism ineffective and reveals a confusion such that this view of scientific realism can no longer be defended. However this analysis also shows that there is one remaining option for science to uphold (or rather gain) consistency: The subject-oriented approach.

This approach claims that mental impressions are “allusions” that, through projection, give rise to the individual’s private universe – its priverse. Based on this view we find a new role for human consciousness and are able to convincingly explain why the “classical reality” is unknowable, as already claimed by Kant. The “classical objective reality” is unknowable because of inseparability – not because of lack of knowledge. This means we can neither know nor assign a meaning to some “objective reality” – however we can still pursue the human activity of science by manipulating entities that are recognised by us as consensual social constructs.

The SOA cannot build on the classical Newtonian paradigm and the need for a paradigm shift in its Kuhnian sense is urgent – as modern thinking regarding quantum physics has already taught us. The feedback loop of the human brain as explored by the early cyberneticians is a crucial phenomenon that will take centre-stage for this paradigm shift.

PART 2. SUPPORTING PAPERS

The second part of this thesis comprises of a collection of papers as presented below – that all have been subjected to minor revisions since the time they were first published. For the orientation of the reader part 2 starts with:

2.1 A survey of the papers - that surveys each one of the 6 papers and relates them to Part 1 and other research. The papers are placed in section 2.3 in the order they originally appeared, which hopefully will reflect the path of evolution of the ideas involved - from the classical Newtonian stand-point as explicated in paper no.1 (1992) until the central one in June 1999 (no. 5) where the inadequacy of the OOA and the Newtonian paradigm is “proven” in the sense that it cannot withstand a consensual acceptance – this is my belief anyhow. The last paper (no. 6) in June 2001 outlines the background and the ideas of a science of becoming. In paper no. 1 and particularly no. 2, however, one can still notice the lingering faith in the classical Newtonian paradigm of science as introduced at the time of the scientific revolution. The final paper no.6 in a sense ties the papers together and places the SOA in a methodological context of science.

This brief survey is succeeded by the section:
2.2 Conclusions and Future Research – that discusses the shortcomings of the classical thinking that confirms the need of a conceptual renewal and an imminent shift of scientific paradigm, which during the 20th century has already been anticipated by means of the findings of quantum physics.

2.3 Collected Papers - finally as presented below - is a collection of papers reflecting how the idea of the SOA once came about and the way this idea has developed throughout the years - from the state of discovery of a slight inconsistency of scientific thinking into a significant factor influencing the further development of modern science foreboding a substantial change of paradigm.

1. An Intuitive Approach to Modelling and Simulation
   Manuscript 1992

2. Does Networking Replace Systems Thinking - or Is It Just Another Facet of Complexity?
   at the NUTEK-conference on Complexity, Sigtuna 1994.

3. Priverse - the All-embracing Private Consciousness.
   at the Xth Congress of Cybernetics and Systems, Bucharest – Aug. 1996.

4. From Descriptivism to Constructivism - a Challenge to Symbolic Modeling.
   at MMA-98 the Third Int. Conf. on Mathematical Modeling and Analysis, Riga 8-9 Oct. 1998.

5. The Subject-Oriented Approach to Science and the Role of Consciousness
   at  the 1st Int. Conf. on Sociocybernetics 1999 in Colimbari, Crete, 25-31 May.
   http://www.unizar.es/sociocybernetics/crete.html

6. Sociocybernetics – the Path to a Science of Becoming?
   at the 3rd Int. Conf. on Sociocybernetics in Leon, Mexico. June 2001
   http://www.unizar.es/sociocybernetics/leon.html
Part 1

1.1 What is the Problem?
1.2 The Subject-Oriented View in Retrospect.
1.3 What is Science?
1.4 What Do We Mean by “Real”?
1.1 WHAT IS THE PROBLEM?

1.1.1 Systems science and the pre-given world

The development of methods for information systems analysis\(^2\) and design has been on the agenda since the advent of the modern digital computer.

One of the major characteristics of science in the second half of this century is the emergence of a number of related intellectual areas such as cybernetics, general systems research, information theory, control theory, mathematical systems theory, decision theory, operations research, and artificial intelligence. All those areas, whose appearance and development are strongly correlated with the origins and advances of computer technology, have one thing in common: they deal with such systems problems in which informational, relational, or structural aspects predominate, whereas the kind of entities which form the system is considerably less significant. It has increasingly been recognized that it is useful to view these interrelated intellectual developments as parts of a larger field of inquiry, usually referred to as systems science. (G. Klir 1985 p.3)

In parallel, the development of computer support for the acquisition, modelling and simulation of processes for the purpose of enterprise control and accounting has proceeded. The rapid development that occurred in the field of hardware and basic software progress made us believe that the advancement in the systems development area was to follow the same pattern. This was not so – the optimistic views of computer-assisted industrial process control, for instance, came to grief for reasons that had little to do with computers – the problem was that we simply did not know how to control the processes under consideration.

The state of the art of information systems design methodology\(^3\) followed the same pattern, there was no time for systematic development and instead ad hoc methods came into frequent use and the way an information system was perceived, described, and conceptually specified largely followed the way computer software products evolved and this situation is still reflected by today’s specification techniques and practical CASE-tools.

The state of the art of information systems design methodology is characterized by hundreds, if not thousands, of more or less similar academic, as well as practical, development disciplines. There is a conceptual as well as a terminological gap between principles, methods, and tools developed in academic environments and those developed and applied in business and industry. Transfer of knowledge, know-how and technology between different groups is thereby severely restricted. The terminological confusion in this field is embarrassing, and difficult to explain to colleagues of other disciplines. (B. Wangler, 1994)

When trying to develop models for computer simulation analysis\(^4\) one often has to face a situation where theoretical knowledge of the process under consideration is meagre and very often based on the operational practice developed by workers – a situation that meant that even the definition of the system under consideration presented great difficulties because of the difference in interests and the variation in goals of the interest groups involved. The build up of personal viewpoints of the system under consideration became a compelling endeavour – and when we straightened our backs after its assumed completion we often found that nobody else was able to understand the views arrived at. Many times it was not even possible to reach a consensual understanding within the group of project leaders. The confusion was often total and the following systems development and implementation become bold ventures indeed.

In this situation the difficulties of communication and cooperation sometimes are paramount and against this background one often wonders whether the classical ideal of objective knowledge is even possible here. This situation clearly parallels the one met with in the social sciences where the lack of an agreed conceptual framework very often results in differences in opinion and a subsequent squabble that threatens to lay waste to purposeful activity. Since many computer scientists are educated in the paradigm of objective science – the Newtonian paradigm, we have seemingly always been able to find some comfort in the idea that science – at least in its academic version - is governed by firm rules and crisp definitions. We have come to understand that the paradigmatic mould of physics was essential to the understanding of science, its phenomena and its successful development – while such a paradigm evidently was missing in the cross-disciplinary projects of information systems analysis.

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\(^2\) See e.g. Flood 1988 and Loucopoulos 1992.
\(^3\) Boman 1997.
When the physical sciences at the beginning of the 20th century developed into a much more theoretical and mathematical fashion not even physics was spared. In 1905 Einstein published his special theory of relativity – as an answer to Michelson and Morley’s attempt to determine the earth’s velocity through the ether⁵ - and shortly thereafter the quantum theory was well on its way. With the acceptance of the new physics, a philosophical crisis emerged: the new physics was incompatible with the prevailing notions of scientific common sense - the Newtonian paradigm.

The problems of the new physics in those days, in a way resembles today’s situation in information systems analysis – the classical way to conceptualise the universe of discourse (UoD) totally broke down. Viewing the world as consisting of objects moving in a frame of absolute space and time was no longer possible. In classical thinking the “objects of the world” belonged to well-known categories that all have well-defined and distinct properties. Such a thinking was not possible any more in the real domain and it now became obvious that such specifications are very dependent on the way in which the observer perceives the situation – in a sense this parallels the situation of the social sciences or that of today’s information systems science. System definition and property descriptions – not to speak about patterns of conceptual association – all seem to be very observer-dependent. Scientific objectivity – the very foundation of scientific rationality – was obviously at stake when discussing human observation.

The question that came to the surface was an old one: “Do our senses mediate a correct picture of the world?” this had already been asked by Parmenides and Protagoras and these reflections and similar have already been met with in the first paper⁶ offered in this thesis: “How do we define the system under consideration and what system view is the correct one?” The physicists of today face the same problem with complementary worldviews, and once a useful model is arrived at we ask: “How do we mediate the ideas underlying this model construction?” For the reasons that classical physics have for so long been successful, we understood this task was possible within a group of well-trained physicists doing classical physics together – but in other situations when we investigate phenomena outside the domain of physics when forming interdisciplinary groups, for instance, the results are often discouraging. Since scientists from different disciplines proposed and made use of incompatible models on a regular basis, it seemed that the idea of observer-independent⁷ observation was the very root of the problem.

One facet of this problem is tacitly buried in the idea that the world is pre-given – which makes us believe that all of us see the world in the same way. This presumed pre-given-ness also tacitly suggests “objective observation” to be possible. On this view the prevalent idea is that if we only learn to look at the world “objectively” (or non-subjectively) the “true” world will appear before our eyes – in consequence also implying that the “true” world is one and the “same” to all of us. For the latter idea to work we need another postulate – that observation-independent human perception is possible – and regarding this question I guess we have fooled ourselves to believe that physical measurements have provided us with this important trait of observer-independence. This is not the case at all. The lessons of information systems practice have told us that, with the lack of a disciplinary paradigm, very little is indeed pre-given and that the phenomena of the world often seem observer-dependent up to the point of total confusion – very much reflecting the situation met with in the social sciences.

A pre-given world “contains” pre-given things that can be described by the assignment of numbers to their “pre-given” properties - this is the idea we embrace classically about a world thus pre-given to human perceptual experience. We believe the happenings of this world – which is fully detached from another world of ideas about it – can be deterministically described by lawful state space trajectories “located” in time. This is a point of view that has recently been subject to serious doubts. Should it, on the other hand, be that the things of the world are not pre-given – then neither are their properties nor the world. Then not even the laws of evolution are pre-given. When the features of the world are not pre-given then the correspondence theory of truth is not applicable – i.e., there is no objective pattern available to generate a “truth/false” conception. And even if the world were pre-given (by some deity for instance) we could not even then take for granted that we all perceive this world in a similar way, i.e., by way of pre-given categories.

⁵ Michelson 1887.
⁶ See collected paper No 1 - An Intuitive Approach to Modelling and Simulation.
⁷ By observer-independent observation I mean that the observations made in principle are independent of the observer doing the observations.
1.1.2 The fatal misconstruction – some reflections.

When approaching human cognition and modelling there are many details that are highly confusing. Let us first consider human cognition and the figure below. Such an illustration (modelling) of the human observation can be found in most science books.

To my mind, this picture is supposed to portray a human being C, looking at something called a car A belonging to the “world,” suggesting that this car A is optically projected through C’s eye into an “upside down image” somewhere in brain. Apart from taking the existence of A as a given, this illustration also suggests this car A reveals its existence in the form of an “image-like miniature” B before the observer in question C. It is also in general unclear as to whether this “image” B is generated on the retina or in C’s mind or somewhere else as the result of further cognitive processing in the brain.

Here we are facing a situation where hidden presumptions and sweeping conclusions are mixed up with the inadequacy of language, to clearly cope with this situation that leads science seriously astray - both at the level of everyday modelling, as well as at the level of advanced scientific modelling.

Let us point out some inadequacies. Firstly, I guess that any reader of this thesis can "see" the car A. However the car marked A is not any "reality-car" at all - A is your perception of "something" printed on this sheet of paper marked A – nothing more and nothing less.

Let us try to clear up what we can say about this "something." We readily identify the "something-on-the-paper" as the "image" of a car. Since you can identify this "car" with such ease, your mind’s impression of A must be very "similar" to the impression you get when looking at an object-of-reality termed a “car.” And since you and I are agreed we can conclude that our conceptions of a "car" are pretty similar. In other words this "something-on-the-paper" A stands for a "something-in-reality" A which is very similar to A - regarded as a private mind-imprint. And here is the point - the illustration above suggests that C has a “similar” impression! How could we ever know? Of course we cannot - the very same moment we for instance, assume C to be a frog instead, we clearly realize that such an assumption is highly misleading. All we can here do is to sincerely hope that C’s perceptual apparatus works the same way as yours and mine does. By the way - do you and I have the “same” impression of the car? I cannot tell – can you?

Secondly, is it very unclear what is the interpretation of the portrayed ”image” B. Does this “image” occurs on the retina and who is then the observer? In this case we reject the idea of a homunculus sitting on the retina – where is he sitting? Maybe there is no homunculus at all – and then, why do we assume this sense impression to be an “image”? What is the relation between the eventual “original” and its “image”? Well, the use of the term “image” implies that there is a mapping procedure at work. However such an assumption take the original firstly to be “pre-given” and secondly extended, and then we unfoundedly establish a Cartesian dualism. If there is such an original that is open to human knowledge, then we must ask why its token should appear as an image? After some considerations we understand the simple reason is: we have no other means to produce a token impression on a sheet of paper but drawing an image token. And the next puzzle remains: suppose there is no original? Then what?

My mind is no sheet of paper, however, so why should there be an “image” in the mind. We are better off when we call this “image” a feeling instead, for the reason that we can all recognise the feeling of “green”, the feeling of seeing a dog, which is different from touching, hearing and smelling “green” or a dog. Should Kant be correct then there is no “knowable” original and then it is even more odd to postulate an “image” in the mind. Consequently the only feasible solution is that the image B stands for (i.e., models) the feelings that C meets with when he observes the allusive car marked A. So in short the illustration in the figure simply suggests that C has feelings marked by B – this is all. However it is a serious mistake is to assert this feeling to be similar to the feeling you have watching the group of dots marked B on this sheet of paper.

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8 Hopefully similar to mine
9 Parenthetically, we will see this ability is not self-evident at all as the everyday human being tend to think - I will claim it is almost a miracle that we can come to speaking term on that.
10 The homunculus is a diminutive “observer living in the mind” in a sense doing the utmost observation
This illustration – which is supposed to be scientific – also suggests that we have direct or perceptual access to C’s perceptions and this is impossible unless one recognizes the possibility of some telepathic communication. In everyday life C has to present his private mind-imprint B in the form of a physical model in order for it to be apprehended by any other living being.

Further figure 1 suggests, as pointed out, that the cognitive function is the bare mapping of a pre-given reality and that the “reality object” A is “objectively” accessible to all (or most) human beings provided that we all know how to observe “objectively.” We must ask whether “objective” observation is possible at all.

Is there even a reality? Figure 1 makes a direct proposition that there is a pre-given reality. The observer C draws this conclusion from the “appearance of the feeling” B – but how does he/she know for certain? How do we? Could it not be that B is a plain hallucination?

We could continue in this vein for some time and end up in total confusion – unless we have not already attained this state. We now understand that this illustration is so full of improper traits and induces misleading assumptions that this model of human cognition should be abandoned immediately. We conclude that the commonsense appreciation of the cognitive process is so intertwined with improper assumptions and jumps into hasty conclusions that we really have to scrutinize the ontological assumptions all over again – and in doing so the whole enterprise of classical science throws up serious misgivings. The illustration in figure 1 is been made in the spirit of the basic dictum of Newtonian science – the scientific observer is the “outside” observer, i.e., the detached bystander – anything else would be unscientific.

This type of careless illustration has appeared in scientific literature so many times that we are now blindly led to believe in them – the same way that Middle Age man believed in God. However there is something entirely wrong about this picture – and this has lead human thinking astray since the dawn of science.

What we have to do is to scrutinize the ontological assumptions underlying observation and in doing so we note that scientific research proceeds on a number of metaphysical hypotheses, which has been pointed out from time to time. Two points from a list of ontological principles – (Bunge, 1977, p.16 -17 ) - occurring in scientific research must suffice here:

There is a world external to the cognitive subject.
The world is composed of things.

Realism takes for granted that there is one and only one world "out there" and furthermore pre-given, which consists of "material objects" or things, as such making up an “objective reality.” Accordingly the very task for science has been to unveil the hidden secrets of the “furniture of the world” existing in and making up this so-called true “objective universe.” This view is tacitly underpinned by permanence, which in turn has paved the way for the overwhelming one-sided interest science has shown these “material” entities - the furniture of the world. That is to say classical physics has to great extent identified the previously mentioned "some things out there" with material physical entities or "things” move around against a background of “empty space.”

The SOA takes another stance – it argues that when an observer speaks about the "world”, he speaks about the content of his private percepts (the phenomena), i.e., his private knowledge about the mental phenomena and nothing else. He consequently speaks about a strictly private universe - the priverse. This priverse is a private perceptual construct, not to be confused by anything deserving the attribution of an “objective universe.” The utterances made by him regarding the "appearance of the world" only have reference to his personal priverse and the statements he makes are thus models of his priverse and nothing else. Certainly a very faint model (or representation) of his private perceptual impression, but nevertheless a model – nothing more and less.

In general we regard the personal world (priverse) as subjective and the scientific world (universe) as objective. Take for instance the example of parallelism expressed by the colour in the personal world and its counterpart the electromagnetic wavelength in the scientific world. Here we have little hesitation in describing the waves as objective and the colour as subjective. The wave is reality - or the nearest we can get to a description of reality and the colour is mere mind spinning – this is the view we uphold. The beautiful hues, which flood our consciousness under stimulation of the waves, have no relevance to the “objective” reality. In this way we produce the illusion of an “objective” and common world. For a colour-blind person the hues are different; and although people with normal sight make the same distinctions of colour, we cannot ascertain whether their consciousness of red, blue, etc. is exactly like our own. Moreover, we
recognize that the longer and shorter electromagnetic waves which have no visual effect associated with them are just as “real” as are the coloured waves. In this and other parallelisms we find the “objective” in the scientific world and the “subjective” in the personal world. The subjective is true for each and every individual living being – but to whom is the “objective” true? And what is it to be true? All these questions must have proper answers – because at present it appears that this is not the case.

There is also another objection to the scatterbrained postulation of an "objective reality"; since we could, following Kant, not even be sure there is anything at all to know “out there.” Here the most radical standpoint of scepticism is solipsism - according to which all there is, is my consciousness and its content i.e., this world is only in my imagination and the only reality is "I" - the "imagining observer." Such a stance is perfectly defensible and as a matter of fact a much better starting point, because then we are in the position to “prove” the necessity of a “pre-given” postulation. The record shows, however, that such necessity is not at all at hand, which puts the realist’s doctrine – that firstly postulates a pre-given world and secondly that observer-independent observation is possible - into serious doubt.

The SOA is useful and, as a matter of fact, the only solution left when the classical OOA breaks down – the way it does in Collected Paper No 5 and the very purpose of this thesis is to describe the way arrive at this conviction. When we, on the other hand, follow the subject-oriented path we end up in (mental) monism and for the sake of understanding I will through the use of the above figure, try to explain how to go from the TPP11 to the more useful FPP in which, the troublesome duplication of the car – on the one hand marked A on the other B – will vanish.

What you have to do is to place your own head at the place of the person C – i.e., virtually “push your head into the paper.” In doing so you come to understand that B corresponds to your car “image” in the mind/brain - “inside” your head so to speak. There “is” no car any more – the car marked A is imaginary – a useful allusion however. You can hit the “clues from outside”, but these clues have very little to do with your knowledge about the car. B, on the other hand, is the knowledge of the car and B is what we refer to when we speak about the car – and in consequence all knowledge is “in” your mind. Your knowledge about the car is not located in two “places” any more - the knowledge is in your mind and A is nothing but the imaginary projection of B - the allusion.

It takes a lot of effort to assimilate this radical point of view – because the imprints of education are so deep – but once achieved, the apprehension that the “world” is nothing but the “knowledge about the environment” – nothing else can be sustained. However then you will also understand there is more to knowledge than the “outside” environment and understand that whenever an illustration such as in the above figure is met with in the future, you must once more “push your head into the paper” and thus make the target object of the “outside” disappear (i.e., to take on the FPP) and then you can happily face only one world – the monistic world of your everyday experience.

1.1.3 A useful way out.

The conceptual confusion and despair of communication met with within information system sciences is even more pronounced than in other research areas, but it evidently also spreads down to physics and mathematics – the exemplars of scientific activity – and for this reason these activities of science have to be scrutinized. One might think we should refrain from such an undertaking for the simple reason that science has a reputation of eminent success – but this situation is not at all uncomplicated. The understanding of living and human behaviour is still very rudimentary and as a matter of fact the very definition of physics and the identification of physics with present day science makes consciousness studies an unscientific endeavour. Since the subject field of consciousness studies12, among other things, aims to explain how we know that we know, means that it sounds odd to judge such an activity as unscientific.

The situation is, in ways, somewhat better in physics – since both classical and quantum physics have proven to be such a useful framework for prediction. However – and this is important - this ability to predict only concerns the domain of physics – in spite of the physicist’s frequent declamatory claims of the closeness of a scientific “theory of everything.” Such a claim is confused because human experience simply

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11 We assume the reader are accustomed to the well-known psychological distinction between the first person perspective (FPP) and the third person perspective (TPP) – sometimes also called the first and third person view

12 Chalmers, http://www.u.arizona.edu/~chalmers/online.html
cannot be successfully conceptualised by using the concept of a “physical thing” - and I think the present situation in physics is as confused as it is in the information sciences – simply because of a very deep confusion at the basic level of Western thinking.

The root of this unfortunate situation lies in the philosophical preoccupation with questions such as: What is essence of thing? What is an object? What is a property? What is real? Unfortunately these, and similar questions, have no answers either in the framework of physics or in that of traditional metaphysics. Accepting this fundamental limitation to the answers we can extract from questions concerning the “objects of science”, we must thus concentrate rather more on scrutinising the very activity of science. In this situation we can perhaps be inspired by mathematics, which at the beginning of the 20th century found that the philosophy of mathematics could not be fruitfully pursued as an investigation into the nature of numbers when they were regarded as abstract entities existing in a Platonic realm. Instead a more successful approach was the study of mathematical practice and the activities of the mathematician with a special emphasis on the function of the fundamental phenomenal objects that are the concern of mathematical research.

In physics we must also deepen our understanding of how we describe scientific experience, i.e., what are the basic objects of description. Let us take the guidance of mathematics and avoid the “essence questions” for the simple reason that they have no answers. In physics and philosophy, as well as in information technology, we must shift the centre of interest from questions about the “essence of things” into their function as a conceptual closure describing human experience for the sake of prediction. This is a way of speaking that plunges directly to the heart of a computer scientist - since he/she readily discovers that these conceptual closures (conceptual schemata) are quite familiar to him/her. He/she here finds structures that are richer than numbers, namely the categorical entities he/she on a regular basis uses in the task of conceptual modelling.]

We must ask what we are doing as scientists and study the practices and activities of all researchers – not only natural scientists. In doing so we must keep a crisp, clear view in our minds of the findings that occurred through the advent of quantum physics: The realization that the observer, the observed phenomenon, and the process of observation itself form a totality that cannot be decomposed into its elements without serious distortions. We must realize that the “detached observer” and the third person view is a crude approximation that is valid only in classical Newtonian physics but certainly not in science in general and as a matter of fact not even in quantum physics. This insight has far-reaching implications for scientific epistemology and the understanding of man, his experience and mental life - especially in the way he envisions his living environment – the reality. This insight will overthrow both the classical Newtonian paradigm and diminish the usefulness of the spoken languages and make man understand that the “world”, as he knows it, resides “within” himself as a part of him. He will then find that the reason for reacting to it as if it existed independently of him "out there” is mainly buried in the story of the biological evolution – an apprehension that has been heavily reinforced by the use of the Newtonian paradigm for several hundred years now. Adjusting this misleading paradigm will make him understand that his reactions are both the cause and effect of his “world” construction – the construction of his very own and private universe - the PRIVERSE.

We have to come to terms with the connection between the pre-given world and the objective one. The idea of objective perception derives from the idea of the possibility of detached perception: We thought we were able look upon the world as through a camera lenses – and by the use of “distortion-less” lenses we hoped to extract true knowledge from the presumed pre-given world – in an act of plain discovery. For a long time we have known that such perception is impossible, most clearly witnessed by the traditional division in primary and secondary properties. However, and this point is important, the day we give up the “quest for truth” we will understand that we all can come to terms with the “consensual world” – the consensuality – and become “objective” in quite a different way. Man’s perceptual system does not work without” distortion.” On the contrary - by learning it adapts towards consensual understanding - and the quest for truth can thus be dismissed as in vain. For that to occur we have only to hypothesize adaptability to the human brain – a state of affairs that current research on neural networks has already shown. Adopting that view one slowly comes to see that the task of science is neither discovery nor a “quest for truth” as classically envisioned. The main tenet of science is rather inter-individual adaptation – the creation of cultures and scientific paradigms that allow for a rule-based consensual understanding as the base for effective and purposeful human co-operation.

1.1.4 Summary

The confusion that emerged in physics at the beginning of the 20th century and – that sometimes is referred to as the “subjectivism of quantum physics” – can be traced back to the ancient Greeks and further to the very situation of a living being. In this situation we have taken persuasive Nature as pre-given – on the grounds of persistence and accessibility – and that has been appointed as the template of truth. This situation cannot be handled unless we assume a dualistic worldview – and we understand this idea is a legacy from our savage ancestors – rather than from some mistake for which we can blame Descartes.

Most scientists consider the world to be pre-given is to consider the objects of the world to be pre-given and this has classically been the starting point for an objective science - this is to my mind the correct interpretation of the term objective. This approach is called the OOA – but this is a risky one because of the “pre-given” postulate. The SOA refrains from this risky postulation and it will appear that, in that way, we can stay clear of the usual and vain “essence”-discussions. Instead the SOA focuses on the very activity of science and next on the agenda is the question: What is science? - However we shall firstly take a look at the historical aspects of the SOA.
1.2 The Subject-oriented View – In Retrospect.

The OOA has been habitual and has dominated Western human culture and the history of science. Very few scientists have tried the subjectivist’s approach and therefore this point of view has never become part of the daily praxis in any science. The philosopher Hilary Putnam recently said: "It is impossible to find a philosopher before Kant (and after the pre-Socratics) who was not a metaphysical realist, at least about what he took to be basic or irreducible assertions"\(^\text{14}\). This assertion can be disputed since Berkeley, for instance, cannot be accused of realism. No doubt we can safely state that very few actually exist. During the past 2000 years, Western scientific traditional philosophers have disagreed about their views concerning what “really exists”, but their use of the truth conception has always been the same - something is "true" only if a decision on that matter can be made on a level above the human being – by some super-observer/decider. This will in due course turn out to be the very essence of what we mean by saying that science strives for “objectivity” – it strives to unveil the view of the (eventual) super-observer. However unless we as scientists are prone to define one, there is no such super-observer/decider. In consequence there is neither a pre-given God nor Nature\(^\text{15}\) that can assist us as instruments in the “quest for truth” referred to by the realists. In spite of that the realistic ideal and the influences of the Newtonian paradigm have proved to be so strong that even the social sciences adhered to it – in spite of the fact that here man was the centre of interest. Small wonder that even man became “objectified” by the scientific view and mankind now suffers badly from this alienation. To find a sphere of activity where the subjectivist’s view is at least accepted we must turn to the humanities. For that reason an introductory historical survey on the subjectivist’s view – as seen through the eyes of a natural scientist - could prove to be useful.

1.2.1 The classical perspective

The legacy of Greece is Western culture, including its early science and philosophy. (Armstrong 1957, Irwin 1989) The cosmologies of Babylonia and Egypt contained some primitive myths that took hold from the fact these countries were conquered from the water and the first known Greek philosopher Thales took over the idea that water was the fundamental stuff in the universe. Although naïve and not very well developed the science of the ancient Ionian Greek science, in its attempts to discover the fundamentals and the early attempts to exploit nature for their own purposes by technical means, reminds us about the attitude of modern sciences.

Herakleitos was the first one to make a distinction between the senses and the soul and once this idea was established, Parmenides led the attack on the Ionian empiricists by using contradiction as the useful logic principle. Nature came back into the centre through another important thinker, Democritus, who claimed that the parts of reality were atoms moving around in an infinite void. To him every conceivable thing was a network of atoms and the properties we attribute things such as sweet, bitter and coloured, not present at the level of the indivisible and invisible atoms - thus pre-empting the modern distinction of primary and secondary qualities.

Later the Sophists – a movement in fifth-century Greece - shifted the emphasis away from the study of nature and gave for the first time humanistic qualities to philosophy. Leaving out the solid aspects of Nature they in a sense became the first systems scientists and accordingly stressed the abstract essence of phenomena and made a distinction between the “things” – the phenomena as given by Nature (phusus) and the ones as given by name convention (nomos). Protagoras, the most influential of the Sophists, advocated the doctrine:

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\text{a man is the measure of all things, of those that are, that they are, and of those that are not, that they are not}
\]

- in this manner paving the way for subjectivism and the SOA and pleading for a strict relativistic thinking. It is unclear, however, whether he actually gave these words such deep significance, but when we take this citation to mean: “\text{a man [the collected private knowledge of his] is the [ONLY] measure}
of all things [to use for the conceptualisation of a UoD]” we find a new basis for the establishment of human consensus. This citation has also been interpreted as to, for the first time, suggest that also human truth is non-absolute i.e., relative the observer/knower – a private truth conception, which in a remarkable way captures the essence of relativism inherent in the SOA.

For this very reason we will dwell some time on the well-known dialogue in *Theaetetus* where Plato sets out to refute such an assertion by a fictitious dialogue between Socrates and Protagoras:

Protagoras: Truth is relative. It is only a matter of opinion.

Socrates: You mean that truth is mere subjective opinion?

Protagoras: Exactly. What is true for you is true for you, and what is true for me, is true for me. Truth is subjective.

Socrates: Do you really mean that? That my opinion is true by virtue of it’s being my opinion?

Protagoras: Indeed I do.

Socrates: My opinion is that Truth is absolute, not opinion, and that you, Mr. Protagoras, are absolutely in error. Since this is my opinion, then you must grant that it is true according to your philosophy.

Protagoras: You are quite correct, Socrates.

Through this dialogue Plato meant to show that Protagoras was mistaken. However he only succeeds in assigning confusion to Socrates. Protagoras reacts correctly by admitting the fitness of Socrates opinion as well keeping up the idea of the fitness of his own. The answer Socrates offers, reveals that he (or rather Plato) does not get the point of the (private) relative truth conception thus advocated by Protagoras, and cannot separate it from a consensual (agreed upon) truth criterion. In this case one can conceive the latter criterion to be undisputable, e.g. given by some deity we speak about an absolute truth. The interpretation of Socrates’ answer: “Truth is absolute” – as the interpretation of any other answer – must be done against the background that this statement is a shortening of the statement “AMO: Truth is absolute” and is thus two-fold. The claim “Truth is absolute”, however, cancels out the part AMO, revealing that Socrates thereby erroneously has taken on the role of ultimate super-decider (God) – suggesting that his statement for this very reason cannot be refuted. By this very statement Socrates claims that his personal opinion is to be treated as the God-given absolute opinion and then he abandons the agreed upon level of equality between debaters – a severe mistake. Such a change of the level of decision (almost hidden) is very common in human communication, and is very often used as a trick to discount troublesome claims from antagonists. The problem here is that Protagoras and Socrates have not yet reached a situation of consensus where they are both agreed upon a common definition of truth. Protagoras would have been better to reply: “Socrates, you are quite entitled to express your opinion and demand admission for that. But you are not allowed to break the rules of our discussion however, by claiming your personal opinion to be the Absolute Truth. In doing so, you proclaim yourself to be the authorized superdecider on what is true or false in our discussion.” The confusion displayed by Plato’s reasoning here has to do with the problem always encountered when meeting somebody claiming that his/her private opinion coincides with the truth, which at the same time is absolute. It is bad enough that someone, without further ado, make his/her own opinion the truth, and when also claiming that this truth is absolute he/she in a self-styled manner takes on the role of divine superdecider.

In the SOA neither God’s opinion nor the guiding principles of Nature are accessible, and here truth is nothing but a relative concept. The consensual truth is relative to the intuitions of a group of deciders. For that reason we, in the SOA, rather speak about beliefs that are useful instead of true. Now, however, we are far off the historical aspects of knowledge, but this extravagance was due to the close parallel between the ideas of Protagoras, as accounted for by historians, and the SOA.

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16 Burnyeat, 1990.
17 AMO = According to my opinion
Returning to the history of philosophy the situation changed dramatically within some two hundred years when the two giant figures, Plato and Aristotle appeared, and their importance is paramount, and to some extent also Socrates – in the way he is known through the writings of Plato. The two first mentioned are probably the most influential philosophers of all times and came to dominate Western thinking at least until the scientific revolution. The literature covering their philosophy is enormous and needs no repetition - here we instead concentrate on the subjective approaches.

In those early days of Western wisdom very few knowledge distinctions were drawn and philosophy was the study of almost everything and for a long period - roughly from the fourth to the seventeenth centuries - Christianity dominated thought in the West. Of course there was also a place for philosophy but much of it served theology or at least it was constrained by theological considerations. Following the “Renaissance” and “Reformation” there occurred in the 17th century a pronounced renewal of philosophical inquiry. It was connected with the rise of modern science, and began by asking fundamentally important questions about the universe and the nature of knowledge in a manner that successively split up into the “natural sciences”, “social sciences”, and “humanities.” This was further divided in the 18th century to psychology and in the 19th to sociology and linguistics; and in the 20th century in the development of computer science, cognitive science, and research into AI.

The modern period in the history of philosophy begins with Bacon’s Novum Organon (1620) and Descartes’ Discourse on the Method (1637), who in a sense was the first consistent subjectivist philosopher. Descartes was in addition, one of the founders of the new natural sciences that came to be the basis of the scientific revolution. The new understanding that followed in the footsteps of this revolution totally changed the assumptions, the methods and the language, which had been the common property of philosophers since the early Middle Ages. It goes without saying that philosophy was deeply influenced by the ideas that were brought about by scientists such as Galileo, Descartes and Newton. Galileo, for instance, prescribed the called for scientific attitude – that later came to bear one of his successors name, namely the Newtonian paradigm, by saying to his contemporaries: “If we want to understand Nature we must consult Nature and not the writings of Aristotle.”

Immanuel Kant’s masterpiece - The Critique of Pure Reason – appeared 1781 and his conscious rejection of the two rival traditions of philosophy – the empiricists (Bacon, Locke, Berkeley, and Hume) and the rationalists (Descartes, Spinoza, and Leibniz) – as matter of fact coined the empiricist/rationalist distinction. Roughly, the empiricists believe that all knowledge comes from, and is justified by sensory experience and the rationalists, in contrast, that knowledge is obtained by organized human contemplation, i.e., rational thought. In a sense these two groups have different opinions on what is important about observation. The empiricist maintain that truth connects to observed facts only and the rationalist, that the human mind is able to decide on that only by contemplation – however both are agreed that science aims at the truth. Kant himself also admitted to the use of a truth conception but maintained that knowledge is the product of a synthesis between these two faculties – in which sensation and thought come together. The SOA takes this Kantian idea one step further – even denying the usefulness of the percept/imagination distinction in the same way Quine18 did. All that is present in human thinking are thoughts (the objects of cognition), which are an irresolvable mix of perception and imagination. Cognition in the FPP lacks reference for a truth decision – which make truth by correspondence an idle conception.

Fichte and Hegel followed in the footsteps of Kant and in Darwin (1859) science met with a new revolution. However the interest in biology and evolutionary theories only counteracted the prevailing mechanistic materialism of the Newtonian paradigm in a minor way, since the latter was further fuelled by the emerging industrialization. Another branch developed in the U.S. when Peirce19 – for whom Kant was the genuine source of inspiration - becomes the father of pragmatism. These ideas, developed further mainly by James (1890), Dewey20 and in parallel with the linguist Saussure. Peirce provided the fruitful ideas that laid out the foundations for a “science of the signs”, i.e., semiotics.

Returning to the natural sciences, the achievements in these fields were remarkable – but the beginning of the 20th century posed new difficulties. Science, as witnessed, is concerned with description, explanation and prediction and since the time of the Pythagoreans mathematics was the selected tool of description, but its foundation was nevertheless quite insecure:

18 Quine 1951.
19 Pierce 1931.
20 Hood 1950.
One of the most surprising facts in the history of mathematics is that the logical foundation of the real number system was not erected until the late nineteenth century. Up to that time not even the simplest properties of positive and negative rational numbers and irrational numbers were logically established, nor were these numbers defined. Even the logical foundation of complex numbers had not been long in existence, and that foundation presupposed the real number system. In view of the extensive development of algebra and analysis, all of which utilized the real numbers, the failure to consider the precise structure and properties of the real numbers shows how illogically mathematics progresses. The intuitive understanding of these numbers seemed adequate and mathematicians were content to operate on this basis. (Kline 1972 Vol.3 p. 979)

So the mathematicians could, for more than 2000 years, be successful without logical foundations – which should have been alarming since mathematics was considered to be the very prototype of scientific reasoning. Through the works of Leibniz, Weierstrass and Cantor among others this situation was considerably improved and Peano (1889) terminated its informal excesses with the axiomatic method. He and Hilbert (1899) consolidated the axiomatic method as Frege (1892) did for logic, incorporating Boolean algebra as introduced by Boole into classical logic. As painting, sculpture, and poetry turned to the abstract after the turn of the century, Whitehead/Russel (1910-13) turned geometry and mathematical analysis into pure logic - a move that was immediately countered by Poincaré and Brouwer (1907) - the latter called the father of constructive mathematics and intuitionism.

The natural scientists still struggled without a firm base since mathematics was unable to help by providing some truthful connection to reality. Is this the sign of some superfluosness of logic or the eulogy about intuition, one asks, or is there some one else perhaps in charge? By the 1870’s mechanistic materialism began to be challenged largely as a result of developments in physiology and psychology, and through the contributions of Darwin, biology had come into the scientific focus and later Freud’s meta-psychology (1961) caught the interest of mankind. However, particularly in physics the situation now became worse. Here scientific description and explanation is very much the same endeavour, but many of the phenomena that we are interested in here do not come with descriptive manuals and cannot easily be inspected or taken apart without disturbing their behaviour. Often one, single observation of a phenomenon will change its state and totally frustrate the build-up of a useful model – this was quite a new situation that had to be faced by quantum physics. The classical way of scientific reasoning did not apply in the quantum realm.

Inspired by E. Mach (1886) the theories of relativity were established by Einstein thus wiping away Newton’s ideas about absolute time and space that hitherto had been the self-evident property of classical physics. In his footsteps, Minkowski followed and he recast the dynamics of moving bodies in four-dimensional geometry and discovered the quantum phenomena that in due course brought the observer to a central position in science. Hitherto, vision had seemed effortless and obvious. We simply open up our eyes and observe the surrounding world. With a passing glance we perceive the shapes of complex objects - at least we think we do - and this we can do whether or not those percepts are familiar to our knowledge. However this apparent ease and directness of observation is highly deceptive, and we now understand that this fact has kept the mainstream of science in a state of confusion for some thousand years.

Science is supposed to be a logical enterprise that aims at objectivity, completeness and consistency. These are the ideals we are striving for - and sometimes we ask the question whether such criteria are attainable at all. Goedel did so, for the conceptual universe of arithmetic, and the result in 1931 came as a shock to the logicians and mathematicians. He showed that mathematics was consistent only when regarded as a closed game – i.e., outside any connection to reality. In the activities of mathematics, as in the game of chess for instance, it might be we can cope with a situation in which correspondence to “reality” plays a subordinate role. In the natural sciences we cannot set aside such correspondence – because all human understanding depends on this correspondence. However in this situation it is of crucial importance to correctly elucidate what reality conception stands for and what is its relation to human knowledge. We must make clear whether its features of both pregivenness and allusion are applicable to reality itself or to knowledge of it.

Logical stringency was supposed to be the decisive instrument of truth, but since truth cannot be injected (by means of proofs) inside a formal system - logic now had nothing more to say about the truth.

21 Kline 1972.
22 Goedel, 1931.
outside its own formalism. The prevailing interpretation is that the blow dealt out by Goedel was harder - that any formal system is in principle incomplete or inconsistent. This was the downfall of the axiomatic method – one thought. This was a disaster since logical stringency was the means to securing the rationality of scientific reasoning.

1.2.2 The streams of the 20th century.

When scientists and philosophers turned to quantum mechanics, they brought with them conceptual tools that had been developed in Galileo/Newton's classical physics, statistical mechanics, and relativity theory. They soon found however, that the new physics called for more. Philosophy of science also turned to greater abstraction – and became almost identical to the philosophy of physics. One can from that notice a clear separation in philosophy between the philosophy of science, (i.e., metaphysics in its literal23 sense) - and the philosophy more oriented towards the social, ethic and aesthetic side of living being and the principles of human learning. The latter took its stance in the ideas of phenomenology – more or less in the shade of Berkeley and Descartes and one can recognize the breakthrough emerging from the ideas of E. Husserl (1917) – who himself passed through such a transition from abstract mathematics to philosophy – in an attempt to formulate a new science of philosophy that he called phenomenology. Ironically enough the ideas of Husserl passed almost unnoticed into the community of natural scientists, mainly catching the interest of the social scientists. So instead of maintaining its reconciling function, classical philosophy also split into two branches – the philosophies of the natural sciences and those oriented towards the social sciences and hermeneutics. For that reason the debate in physics, most typically quantum mechanics, became the central core of philosophy of science, if not to say took its place. For several reason this split became an obstacle to further progress. The physicists, for instance, did not clearly recognize that quantum physics met with an old problem encountered in the social sciences – the situation that the observing scientist influences its object of observation. Many philosophers by profession, so to speak, were blindfolded by the scientific debate and the Newtonian paradigm – obviously forgetful of its limitations.

The subjectivist’s approaches were tried on and off during the 20th century24 and one can notice several “branches” of subjectivism flourish. One such branch is called “historicism” – here we can follow a path from: Protagoras ➔ Vico ➔ Heidegger ➔ Derrida ➔ Gadamer ➔ Kuhn and another one we find in biology; Uexkull ➔ the cyberneticians ➔ Lorentz ➔ Tinbergen ➔ Roessler. Turning to constructive mathematics we find another path; Brouwer ➔ Heyting ➔ Troelstra ➔ Loef and in parallel some similar serious attempts in physics: Mach ➔ Russell ➔ Whitehead ➔ Bridgman ➔ Carnap ➔ Eddington ➔ Basr ➔ Lucas. Also very important and successful are the assiduous attempts in traditional philosophy following the lead from: Brentano ➔ Meiong ➔ Husserl ➔ Heidegger ➔ Merleau-Ponty ➔ Lakoff.

The most influential movement of this period, however, is logical positivism that emerged at the beginning of the 20th century as a response to the metaphysical excesses of Hegel and his successors – and influenced by Frege’s developments in logics, Whitehead/Russell’s (1910) Principia Mathematica and the Machian program in physics. In a sense the Machian approach is very close to Husserl’s – they both investigated the phenomena of mind – but the deciding difference was that Husserl totally brackets the question of an “outside” reality. The logical positivists, on the other hand, tried to connect to “reality” by means of logic and the use of an “observation language” thereby abandoning Mach’s original subjectivist ideas. Quantum physics, on the other hand, is in many camps regarded a subjectivist program – and the primary ideas of the Copenhagen interpretation (Bohr 1958, 1963) was very well confirmed by Bell’s (1964) later findings – even if Bell himself, which was no surprise, was a convinced realist. In general physicists are realists by profession so to speak, and for some reason most physicist’s even refuse to discuss the essence of the Newtonian paradigm as used in physics. Apart from Bohr and Einstein we find Bohm, Wigner and Wheeler as the most prominent exceptions, see e.g. Wheeler & Zurek(1983).

H. Putnam (1981), supported by Lakoff (1987), points out that the “internalist” – the first person observer – cannot by reference give meaning to the objectivist’s (externalist or third person observer’s) account of science – which means a heavy blow to scientific objectivism. He shows this is a principal (biological) limitation imposed on human observation/conceptualisation and in that view the “reality” as we understand it is structured and conceived by the conceptual schemata we use for the explication of things.

23 The subject matter metaphysics interpreted as super-physics
24 See e.g. http://www-groups.dcs.st-and.ac.uk/~history/BiolIndex.html
Thus human knowledge concerning reality cannot be pre-given, but rather established by human convention. Thereby he confirms Kuhn’s (1962) suggestions that call for a more pragmatic approach, which is also advocated by Rorty (1980). Late in the 20th century there was another backlash in favour of realism in some circles when the Semantic View[^25] as introduced by P. Suppes[^26] experienced a revival. Realism also spread into the field of consciousness studies where the physicists have tried what has been called the quantum approaches to consciousness[^27]. The voices from quantum chemistry and biology are in opposition - as are those of Finkelstein (1996) and Stapp (1993).

1.2.3 The computer sciences.

At the beginning of the 20th century Hilbert set out to axiomatisise the whole of mathematics – but Goedel and Turing delivered some heavy blows to both mathematics and science. According to most interpreters Goedel (1931) showed the insufficiency of the axiomatic method and Turing (1936) showed by his solution to the “Haltungsproblem” the shortcoming of the ideas behind traditional human decision making. Tarski’s treatment of the truth problem changed the interpretation of logic – but for some reason this did not shake the realist’s doctrine. Bell’s theorem (1964) on the other hand came as a misfortune to most realists but even this could not – as little as the advent of quantum mechanics - induce them to abandon the outdated Newtonian paradigm, which by then had at least been modified by the theories of relativity.

The works of von Neumann and Turing gave birth to a new branch of science – something in between[^28] mathematics and physics - called computer science (Brooksheer 1997). The first computers were mechanical but soon the electronic valve gave a new speed dimension to automatic computing. Since electronics was regarded as a classical topic of physics people mainly from this discipline were recruited for its developments, side by side with the mathematicians.

Very soon the obvious distinction between computer hardware (solid state physics) and software (programming) became evident, and in spite of the fact the scientist’s in these both branches had been brought up in the Newtonian paradigm, the software specialists very soon became allied to abstract mathematics. General systems theory (GST), computer programming and abstract thinking became the daily agenda in this area. Computer science has a special interest in processes because algorithms (programs), the special province of the discipline, describe processes in a closed form. The emergence of the digital computer meant an outstanding opportunity to study and manipulate processes in the abstract, i.e., by the use of symbols. In the beginning the sequential process was very much in focus, because it was analogous to the computing process. In due time the idea of modelling the world solely in sequential processes was abandoned and when computer scientists later included parallel processes, further dimensions were added.

It was the growing demand to understand neural networks, human perception and consciousness as well as the needs of AI that brought about the upsurge of parallel processing and computing. On the other hand we must, since the process of conscious experience is a genuinely serial process, ironically enough stay with the sequential process to understand human conceptualisation and this is one reason for the computer scientist’s pronounced interest in human consciousness and intelligence.

Hardware electronics upholding of the traditions of classical physics, were developed via solids state physics into VSLI design. Here the classical framework of Newton and related thinking did not always fit, but the oddities, e.g. the tunnelling effect, were usually, in one way or another, successfully incorporated into the mould of classical thinking. Computer and software engineers very soon became accustomed to the ways of thinking involved in GST and as with the working mathematicians, freed themselves from thinking of software development in terms of manipulations of some pre-existent reality. Process-orientation became the name of the game and the classical physicist’s interest in the “objects of the world” naturally transformed into an interest in the processing subject itself – the computer. In that sense computer science is naturally subject-oriented and interest is here focused on the “internal” processes of computing rather than on its objects – the abstract data types. Many of tools were developed for the analysis of these processes, rather than the objects taking part in these processes, and this gave rise to a fruitful new way of action-oriented thinking.

[^26]: See Mogenbesser 1967.
[^27]: http://listserv.arizona.edu/lsv/www/quantum-mind.html
[^28]: Or maybe bridging them
The advent of the digital computer enabled another new tool to emerge that allowed very complex or extensive mathematical models to be solved and Operations Research (Churchman 1966) arrived during the Second World War. At first it housed disciplines such as simulation- and decision analysis. Norbert Wiener (1948) inspired by the success of control theory (Dorf 1967, MacDonald 1981) and Operations Research now introduced cybernetics as the new discipline. He called it the science of control and communication in the animal and the machine. The field was interested in the concepts of information, feedback, and control, generalized from specific applications in engineering to systems in general, including systems of living organisms, the nature of purposive, goal-seeking behaviour in natural and man-made complex systems.

From the outset, key thinkers recognized that there is a fundamental unity of interest between cybernetics and the general systems theory (GST) but historically they had developed in different contexts. GST argues that however complex or diverse the world that we experience is, we will always find different types of organization in it, and such organization can be described by concepts and principles that are independent of the specific domain at which we are looking. Hence, if we would uncover those general laws, we would be able to analyse and solve problems in any domain, pertaining to any type of system. GST has always stayed true to the classical paradigm of science, but cybernetics has, in contrast, elaborated the meaning and information is an attribute of human social interaction very much in the same way as in the sociocultural domain.

The feedback mechanism, and its appearance both in man and the machine, was the phenomenon that inspired Wiener, von Neumann and their colleagues to develop the conceptual framework of cybernetics during the legendary Macy Conferences. Computing machines and living nervous systems were on the agenda and fairly soon brainwaves and self-organizing systems also came into focus catching the interest of many disciplines, particularly representatives from the social sciences. The computer was the reason for the explosive birth of AI which then dominated the hard sciences and resulting in only a handful of researchers staying loyal to the ideas of cybernetics. Among them von Foerster (Segal 2001) became a major catalyst for the idea of self-organisation and worked away from the reductionist mainstream ideas – almost obsessed by the idea of circularity inherent in self-organisation. In this work they confirmed an important idea from the newly born quantum physics, namely that the observer must be included in the description of the system observed, but adopting quite a different approach did this. This finding was considered astounding, because these findings violated the basic principle of Newtonian science that flatly demands the separation of the observer from the observed.

They found support from biology where H. Maturana recast the concepts of "language" and "living system" with a cybernetic eye (Maturana 1988). In shifting their opinions away from the concurring AI perspective they stated: "Learning is not a process of accumulation of representations of the environment; it is a continuous process of transformation of behaviour through continuous change in the capacity of the nervous system.”

The field of AI came into being when the concept of universal computation (Minsky 1967) and the popular view of the brain as a computer were combined. Cybernetics started before AI, but the latter has totally dominated for the last 25 years. For that reason much of the modern work in neural nets rests in the philosophical tradition of AI, and not in cybernetics. However the current fashion in neural networks could well be seen as a return to the starting point of cybernetics, which occurred during the Macy conferences. Now, recent difficulties in AI and modern findings of cognitive sciences have led to renewed searches for solutions that mirror the past successful approaches of cybernetics. (Winograd 1987) To me cybernetics provided the very impulse to the solution of the consciousness puzzle (Chalmers 1995), included in the SOA, which in a developed state means that the natural sciences by the definition and assimilation of human feelings and intuition can meet with in a sociocultural domain partaking the defining of a unified science of becoming.

In parallel to the theoretical developments, the other side of computer science developed even more rapidly, where the computing methods used in technology were applied to the social sciences. Computer aided information processing became the vogue giving rise to disciplines such as business data processing, industrial process control (Savas 1965) and management data processing (Schoderbek 1990) and this development demanded a more in-depth interest in systems modelling and efficient methods for the development of information systems. During this time a great variety of ad hoc methods emerged – but there was also time for more systematic development in this area. (Langefors 1967). Following Fortran II (1957), problem-oriented programming languages developed (Horowitz 1984) and an extended period of time
programming was structured along the lines of “process thinking” (Rumbaugh 1991) that are characteristic for computer science. At the beginning of 1990’s object-oriented programming, design and thinking (Booch 1991) took over in an expansive period where Internet, fibre cables and satellite links caused the explosion of Information Technology – the new technology that immediately allowed the new learning methodologies to become available.
1.3 WHAT IS SCIENCE?

"Science is what we have learned about how to keep from fooling ourselves." - physicist Richard Feynman.

Knowledge accumulation, modelling and succeeding application are important human activities. They all aim at prediction and explanation. Such processes are realized both on the private and collective level – in the latter case this activity is sometimes called science.

"Scientific knowledge is proven knowledge. Scientific theories are derived in some rigorous way from the facts of experience acquired by observation and experiment. Science is based on what we can see and hear and touch, etc. Personal opinion or preferences and speculative imaginings have no place in science. Science is objective. Scientific knowledge is reliable knowledge because it is objectively proven knowledge." (Chalmers, A.F. 1978 p.1)

This is what Alan Chalmers calls a “widely held common-sense view of science” in his book “What is this thing called Science?” and suggests that this citation in a sense sums up what we scientists in modern times call scientific knowledge. This view first became popular during the scientific revolution that took place mainly during the seventeenth century and scientists such as Galileo, Descartes and Newton. At that time Galileo defined the developing scientific attitude by saying: “If we want to understand Nature we must consult Nature and not the writings of Aristotle.”

1.3.1. What is Nature?

First of all we must observe that the emphasis on Nature meant that Galileo was speaking solely for the upcoming sciences of Nature – i.e., the natural sciences. Secondly, we must remember that science is just a special kind of human knowledge, and science obtained its very definition through the advent of the scientific revolution and then most of all through its sense of the science of Nature. However the understanding of Nature and predicting the happenings of the “outside” environment is certainly not all there is to human knowledge – not even to scientific. Nevertheless science has since this revolution been identified with the natural sciences and particularly physics that has become the exemplar of scientific activity and knowledge. (Lakatos 1970).

The progressive forces of the seventeenth century came to see as mistaken, the preoccupation of medieval natural philosophers with the works of the ancients, especially Aristotle and the Bible, as the main sources of knowledge. The historians tell us that personal opinions and excessive speculation at that time had become a vogue – the new science was to become non-subjective, i.e., objective. Spurred by the successes of the alleged “great experimenters” such as Galileo and Newton, Western culture came more and more to regard human experience as the true source of knowledge. Chalmers concludes: “this assessment has only been enhanced since then by the spectacular achievements of experimental science.” This attitude is by no means unique for Chalmers since most of Western society, including its scientists is filled with a disproportionate pride that sometimes borders on arrogance, considering the fact that we can land a man on the moon but lack the necessary understanding of human behaviour to prevent even small human conflicts. Chalmers cites J.J Davies (1968) "Science is a structure built upon facts" and to make the connection to Galileo and Newton evident he accordingly suggests, “Nature is the source of facts29.” In the same vein as modern physics he asserts “Nature is the ONLY true source of facts” and thereby he carries classical science to its extreme.

But what if there is no Nature? At first sight such a question sounds very conspicuous - as if we have suggested that there is no Nature at all – but this is certainly not the intention. The suggestion here is rather to avoid taking Nature as pre-given in a sense of some knowledge given to a human being. Nature may or may not exist – this is not the issue here: What we are questioning is the nature of human knowledge about this presumed Nature. Is it really correct to assume that knowledge of Nature is pre-given and/or directly accessible to us by straightforward observation? And further, on what grounds do we assume such observation to be objective? Does the existence of the pre-given physical world also imply that the knowledge of it is pre-given? Certainly not! However, very often when we speak about the world, we refer to

29 The signification of the term “fact” is touched upon in Collected Paper No 2 of this thesis.
our personal (or maybe consensual) knowledge of this world - and not to the world-in-itself - herein we can
an important part of the confusion of modern science. Suppose there is no pre-given knowledge of the world
to be found “in” the physical (real) world “itself” – but rather that such knowledge is generated the very
moment some “clues from outside” meet30 with human experience? In this situation we cannot possibly
“directly” collect such knowledge by observation in order to build a base of knowledge (KB) and we can
neither do so on the personal plane nor on the plane of common scientific knowledge. Such a state of affairs
should mean a devastating blow for the celebrated experimental methodology of science that is very
dependent on observation.

For that reason we must pay attention to the scientific activities around this traditional process of
knowledge “collection” – we must scrutinize the presumed objects of observation and the very activity of
observation, i.e., its process and we must find out how we compile these observations to accomplish the
goals of science. Such a specification of the epistemology of a discipline will account for its goals,
methodology, and the subject matter of the field – in short its philosophy. A philosophy of a discipline can
for these reasons not be separated from the very practice of the discipline.

In short we need a description of the objects of the UoD and a description of the very process of
this description, i.e., a model of the objects and a model of the modelling process, i.e., a metamodel of modelling.
The very moment the rules regarding these two modes of descriptions (modelling) are understood, shared
and practised by scientists we can speak about a scientific practice. We understand that, for the sake of a
clear interdisciplinary understanding, we need something different form the abstract traditional model types
as presented in mathematics and the philosophy of science – we need an intuitive model of modelling. In such
an attempt we must also try to refrain from the perhaps necessary but confusing “word wrestling” of classical
philosophy.

However, bringing forth such models is not enough, since we must also investigate the ways in which
we exchange and discuss (communicate) the knowledge accumulated in our private KB. We do so by
explicating our thoughts and impressions – we also call this modelling (see section 2.3) – and for this reason
also the process of communication is of crucial importance for the understanding of human scientific
enterprise. As a matter of fact we should rather speak about the human enterprise of living rather than doing
science – since most human knowledge collection lies outside the realm of pure science and for that reason
we can accept the as “art” classification of the process of modelling.

1.3.2 Science as a group activity ruled by paradigm.

Following Piaget (1937) we just have to watch the play of our children to understand that the pattern
/action – observation/- i.e., experimentation - is the means to master living on a private basis (learning)
and the very same pattern clearly repeats in science – but now on a group basis. However the group activity
of science calls for common rules and controlled interpretations and as such the normal science should be
governed by a paradigm according to Kuhn (1962). Since all group activities seem to be governed by
paradigms, tacit or not, we might ask in what way scientific knowledge differs from other types of
knowledge. To explain and understand the phenomena of life is one reason for the activity of science – but
this is also the common theme for both religious and political activities as well as human culture and fine art
that convincingly explains the dreams and experiences of human beings on a very subjective level.

However, accurate prediction is very special to science, and in a sense the very essence of science -
both on the private as well as on a collective level. This task is crucial for the living individual and mankind
as a species. Undeniable successful prediction requires well-attested (proven) and reliable (stable) decision
procedures (models) used by competent predictors (scientists) - otherwise one misses the goal.

On the private level we, through our own will, can develop useful habits such as good powers of
observation, rational thinking and the ability to measure action in order to cope with the intricacies of life. At
the collective level of a mature science we are in need of a precise paradigm to guide the activities, i.e., a
reliable methodology. We need precise rules as to how to prepare scientific observations, how to carry
through observations and how to compile the data collected into the KB of science. We need a set of precise
rules of explication (modelling frameworks or languages) stating how to compile this knowledge into a set of
models, i.e., structures capable of answering questions about the phenomena involved. These structures must
at the same time possess an intuitive appeal to human everyday experience, i.e., provide useful analogies –
because this is the only meaning we can give to human understanding. The description of a phenomenon

30 We can really hear the echoes of Niels Bohr (1963)
must be done in such way that a normal human being is in possession of some everyday experience that can “stand under” (under-pin or support) the description made, i.e., understand the description made. We suggest this is how the common man’s experience of the everyday world relates to scientific knowledge. When we able to relate the knowledge extracted from scientific models – imaginary or not – to the happenings of in the every day’s world then we can say we understand the world and also use this understanding for our personal survival.

When we return to the problems met with at the time of the scientific revolution, we understand that the choice to consult the physical world (in physics) to extract the facts meant a choice of a specific scientific methodology. Part of this methodology is the explicit instruction to assume the position of a detached (or third person) observer when doing science - which in time has become the ideal of the rational scientific mind. The aim was, of course, to prevent lose speculations and personal opinions and the best way to accomplish this, one believed, was to cut off human intuition and feelings from the picture of science. Unfortunately mankind, or rather the physicists, thereby also placed the human mind, being and society outside the legitimate realm of their new science – or rather the movement of the natural sciences. For that reason the social “scientist” is sometimes met with condescension, but the picture is slowly changing now that the prominent representatives of the natural sciences have also taken an interest in the puzzle of consciousness. Oddly enough, I would say, since a physicist should, by the very definition of physics, not pay much attention to the workings of human mind. After all consciousness studies are by definition metaphysics – or a science of sciences.

Classical physics, by the above-mentioned dictum, is paradigmatically based on detached observation and experiments – and theoretical physics on detached observation and contemplation (mental experimentation). Physics builds entirely on the detached third person’s knowledge and there is simply no physics developed for and from the first person’s (common-sense) view. Quantum physics also required a different paradigm, but is in its present state unfortunately a confusing mixture of Newtonian thinking and the newly introduced action-oriented FPP. However the main reason for this approach is not to avoid the influence of human feelings and subjectivity on the process of observation. In this case classical physics must be abandoned because human observation influences the objects of observation by the very act of observing.

In physics, we are in the position of detached observers able to discuss Nature and its properties and behaviour using the “language of physics.” This “language” is very much couched in logic, mathematics, illustrative graphics and natural languages, they are all different modelling frameworks and also all constructed from the third person’s perspective (TPP), in perfect agreement with the rules of classical science. This framework of models – as part of the physicist’s paradigm – for that reason cannot possibly describe the human mind. We need a new paradigm - not just for physics31 – but also for a genuine science of mankind.

In this new science we must discuss physics as part of our understanding of Nature. Such discussions should be carried out at a meta-level of physics - using different meta-languages and not the “language of physics.” We must restore the stained reputation of metaphysics and use it as a framework when discussing science, i.e., a science of sciences discussing the objects and methodologies of science. For such discussions about the structure of the “language of physics”, which is partly similar to that of the natural languages, the TPP is improper. Here we can see a profound limitation of most natural languages, since they all have evolved over the course of time to describe Nature mainly from the common person’s point of view. This common-sense view of Nature is the TPP – the perspective of the detached observer. Needless to say here we are obstructed by our natural languages that in turn are the exemplars of logic. We are indeed we are deeply caught in the TPP.

We understand that the detachment and alienation suffered by mankind is very deeply rooted in human culture and in our Western way of thinking. It is almost impossible to free oneself from the habitual way of TPP-thinking that man has developed in his fancied capacity of a detached observer of his environment that became the very ideal of human reason through the event of the scientific revolution – which today however more and more appears to deserve the epithet of a “scientific confusion.” The human being was never and can never be detached from his object of observation. Human perception is the FPP only – the TPP is a misleading scientific artefact.

31 Well physics need also a new one when facing quantum phenomena
32 Of course the “language of physics” is a subset of this meta-language.
The confusion is not that the science of physics accepted the detached observer and TPP as a part of its paradigm – almost tacitly – while its great scientists through their deeds remained subjective depending on their scientific feeling and intuition. The confusion is to confuse science with physics – an aberration made clear by Kuhn who clearly demonstrated the social features of the modern activity called science. He stresses that the existence of a paradigm capable of supporting a normal science tradition is the characteristic that distinguishes science from non-science. Since much of modern sociology lacks a paradigm it in consequence fails to qualify as a science – which also goes for consciousness studies. However, this is too crude a determination as Feyerabend (1970) points out, but nevertheless we can concede that an activity lacking of a paradigm cannot possibly be called a science. On these grounds we can safely state that the objects of science are human knowledge – knowledge entities that are brought out under controlled conditions (ruled by a paradigm), as the result of group activity (a scientific discipline) and by trained knowers (scientists). It aims at communication and prediction, and this determination we must add in order to exclude other group activities such as sports and music for instance. The important question addressed by this thesis is whether we bring out such knowledge in plain acts of discovery or involved acts of construction.

1.3.3 The brushed aside mental domain

For some reason logics and mathematics that both expose very firm and well-defined paradigms do not count as sciences. Oddly this means that also the “art” of human thinking does not count as a science. This situation is best illuminated in the struggle of “consciousness studies” to become recognized as a science. Since there is no science of thinking, nor a “science of sciences”, as once proposed by von Foerster the situation stands out as being rather bewildering. Metaphysics too has brought a stained reputation down upon itself and also does not count as a science. For that reason scientists – alien to the very province of philosophy – are often the ones doing metaphysics today. A citation from Bunge (1977) will in part clarify the situation:

Metaphysics has often been contrasted with science for allegedly being speculative rather than empirical, hence irrefutable. So it is in many cases. However this is far from necessary; ontology can be consonant with science and just as scientific as physics, even though there will never be any metaphysical laboratories.

We shall argue that (a) scientific research is guided or misguided by metaphysical principles - some good, others bad; (b) both science and technology have produced theories that are scientific as well as metaphysical, and (c) it is possible to build systems of scientific ontology. If this is so then there need not be any hostility between science and (scientific) metaphysics. There is not even a gap, let alone an abyss, between them: ontology is general science and the factual sciences are special metaphysics. In other words, both science and ontology inquire into the nature of things but, whereas science does it in detail and thus produces theories that are open to empirical scrutiny, metaphysics is extremely general and can be checked solely by its coherence with science. (Bunge 1977, pp. 15-16)

On one point he is mistaken however: Even if scientific ontology can be and very much has been consonant with speculative physics - ontology will never qualify as a science, because properly examined the real/unreal distinction has one answer only - undecidable. This recognition immediately leads to the science dedicated to abstract phenomena, i.e., the province of computer science. This science, with its somewhat unspecified paradigm, will also provide the metaphysical laboratory that Bunge above is unable to comprehend – simulation analysis and computer simulation.

So we find ourselves and science fenced in by a situation where the science of “real” (physics) - and the art of the “imaginary” (mathematics and logics) – both with a reputation of being well-developed and very successful – are still perfectly unable to make sense (in both literal and symbolic respects) and turn their backs on the rest of human research activity. The crucial question here is what are their respective UoD’s? “Is the science of the "real" all there is to human science?” – i.e., in natural science and physics and “Do the numbers constitute the entire UoD of mathematics?” We understand that the question what are the objects of human research activity is finally the decisive one – independent of whether we call this very activity a science or an art.

1.3.4 The objects of scientific investigation.

“What are the objects of scientific research?” is thus the question par excellence and since also the society of mathematics, filled up with its own research “brackets” the real/unreal question, this very

33 Achievements in this discipline are for some reason not even awarded the Nobel Prize.
question, oddly enough, has re-emerged within computer science. Maybe this is not so surprising after all, since most computer scientists are brought up in the paradigm of physics – which is also the province of modern technology. In contrast to other scientists they have acquired more training in thinking and working in the abstract because their entire UoD is abstract, for instance when researching the structures of computer software. Systems thinking and abstract processes are here on the daily agenda, and as time goes by one becomes accustomed to a thinking with no reference to reality whatsoever. When involved in simulation we most often “play” according to the rules of some imagined or artificial universe, e.g. a cellular automaton and in this situation one all of a sudden discovers that there is no need for the “real world” as spelled out by classical ontology and traditional physics. All of a sudden one realizes that one has unknowingly crawled out of the very paradigm of physics, and has thereby allowed oneself to escape the spell of the realist’s doctrine.

The question as to whether the “furniture of the world” is real or not is mainly a question as to whether human knowledge is collected or created. For a long time, both scientists and philosophers of eminence, however, have understood that the very questions “What things are real?” or “What stuff is the world made of?” are undecidable. Unfortunately this insight has not yet penetrated the scientific paradigm in its fullness. On the contrary, in spite of the modern findings of science we still cling to the Newtonian way of thinking and many physicists have rather stubbornly remained defending the position of the realist’s doctrine, perhaps sometimes under the misconception that physics would vanish alongside the realist’s doctrine.

“What are the objects of human scientific endeavour?” seems to be the most important question to address. Science – or at least physics - is a collection of well-attested theories, which try to explain the patterns, regularities and irregularities found among the phenomena studied. There are two main kinds of investigations that this suggests. We can ask what is the status of:

1. *Human knowledge* – i.e., what is the “content” of theoretical knowledge
2. *The phenomena* about which we are supposed to know something

The first question is self-referential as we then ask what “human knowledge” has to say about itself, i.e., what its content. We understand that this, as a first approximation, has to do with what can be “contained” in a statement and here we usually think about a statement such as this as being contained in a natural language. However, further reflections indicate that such a statement refers rather to a model statement, i.e., a statement as expressed in some specified modelling framework. Accordingly this question can be reduced to:

a) What model statements we are able to express?
b) What is the expressive power of the modelling framework chosen?
c) In what way can a thinking creature build a KB by means of such pieces of knowledge?

This is an intriguing and interesting question that we do not aim to answer in this context. We rather leave it at present, concluding that it mainly connects to the second step in the metamodel of modelling, namely the modelling path.

The second question, on the other hand, lies at the centre of the question at issue in this thesis. “What are the phenomena that the contents of our theoretical knowledge refers to?” and further: “How do they relate to the phenomenon we call the world?” The answer to these questions, if any, answers the question about what is the reference of knowledge and in particular scientific knowledge.

Van Fraassen (1991) puts it somewhat differently:

There is quite a difference between the questions `What is happening?' and `What is really going on?' Both questions can arise for participants as well as for spectators, and usually no one has more than a fragmentary answer. To the second question the answer must undeniably be more doubtful, because it has to be somewhat speculative in the interpretation it puts on what happens. Yet both questions seem crucially important.(van Fraassen, 1991, p.1)

34 By this question we unfortunately are left with the object-oriented worldview – but at this stage we have no other choice since the natural language is object-oriented and any attempt to break with this tradition will deprive us of this language.
The first question: “What is happening?” is a question of how a particular, recognized situation evolves and can be answered by the use of a model - and this model need not be anchored in the idea of some presumed reality. The other question, however, in addition, asks about the model’s relation to some presumed reality lying behind the phenomenon. By stating “both questions seem crucially important” van Fraassen, as a prominent defender of empiricism, reveals that empiricists are also deeply caught in the classical paradigm of science, because he is not content with a abstract description of the “happening.” In the second question, considered by him to be important, he wants to know “what is really going on”, i.e., the status of the real phenomena underlying the perceived happening, thereby suggesting such knowledge possible. This is a typically classical point of view – he asks about the status of the pre-given actors (the essence of things) in the happening mentioned. The claim of this thesis is that the second question has no importance at all. As a matter of fact this very question is undecidable and here we can very well iterate the well-known claim of Kant: The thing-in-itself is unknowable. This insight, in part, explains the outstanding successes of mathematics and computer science as useful tools in all knowledge domains, because if the essence of a phenomenon is unimportant its name, in isolation, can act as a “placeholder” in the analytical “chessplays of computation.” The essence of a phenomenon is undecidable. Perhaps the shortest route to this insight is to ask oneself what type of scientific description do we expect as an answer. We cannot simply give a reasonable answer to such a question. The question “what is the ontological essence of things” is undecidable for the simple reason that the distinction between ontic/epistemic essence is void. Quantum physics, and in particular Bohr’s Copenhagen interpretation would agree and for that reason we have to reassess Berkeley’s immaterialism, which has been considered to be irrefutable, but still highly incredible – and which has also, rather unfairly, often been held up as an object of ridicule.

Throughout history the controversy between realists and anti-realists has seemed insoluble - to the great detriment of M. Dummet (1978) for instance. We claim that the main reason for this confusion is the inability to clearly formulate the paradigm of scientific realism, an inconvenient situation that also has concealed some of its inconsistencies. T.S. Kuhn (1962), on the other hand, taking the view of a historian, saw science mainly as a social endeavour and thus – almost by accident – happened to sidestep the realist’s paradigm. He does not connect scientific activity to the discovery of some “outside” world but rather concentrates on science as a group activity – spelled out by a common paradigm. Thereby he successfully avoids relating his “disciplinary matrices” of the paradigm to some Nature (or presumed truth). By this move the paradigm concept can be used to define other, quite different, bodies of knowledge or even myths. We can simply remind ourselves about the religious creation myths and their role in all religious movements. Through the emergence of Kuhn’s view on scientific activity we can once more identify two rival and opposing paradigms of scientific knowledge: the realist’s and the instrumentalist’s approach. We have also learnt that most tenets of, for instance, immaterialism, anti-realism, empiricism, phenomenalism and idealism are all enclosed in the instrumentalist’s view. The deciding difference of this contrast is that instrumentalism does not make any commitment whatsoever regarding the second question above – and for that we are in a better position to stay consistent. The greatest hindrance for its acceptance is the very counter-intuitive approach as it appears to the classically trained mind.

For that reason this thesis is concerned with theories about the very nature and status of scientific knowledge – which ends up in a proposal about a SOA - that as a matter of fact is also able to embrace the classical OOA, but not in the guise of the realist’s approach. This transition of thinking is hard and laborious, - and for that reason this thesis is rather the story about the actual tour leading to this conviction. We shall be concerned with theories about the meanings of certain kinds of words appearing in our scientific theories that belong to our most celebrated concepts, such as things, states, properties, statements, truth and objectivity. The SOA will change the very meaning of these words as well as the status of the world we call reality as given to us through the classical approach. For these reasons the acceptance of the SOA is likely to meet with heavy resistance – so clearly predicted by Kuhn. In a sense the emergence of the SOA gives a great support to Kuhn and his theories about scientific progress and revolutions - and the very role played by scientific paradigms.

1.3.5 The essence of the objects of scientific investigation.

Kuhn was, quite correctly, accused of scientific subjectivity. However his critics failed to understand that this approach is a useful one to use in order to gain scientific consistency. Quantum mechanics is also accused of subjectivity and when the physicists of the early 20th century turned to it, they brought with them the conceptual tools that had been shaped in encounters with Newton’s physics, statistical mechanics and
relativity theory. Schroedinger’s wave-function and its statistical interpretation was something new and confusing and some of them probably felt they had already moved a considerable distance from the ideas of Newton. Quantum mechanics was a success in its predictive power – but still lacked a sound explanation and was still very confusing, because many physicists still try to squeeze this new physics into the framework of classical thinking. As H. Stapp (1993) remarks: “Classical physics strives to exclude the observer from physics and succeeds. On the other hand quantum mechanics strives to exclude the observer and fails.” The physicists found that the new science emerging at the beginning of the 20th century called for more than a change in terminology. Apparently they did not know that the subjective approaches had been tried previously, and had been rejected as non-scientific philosophies. Probably the idea of using such an approach did not cross their minds - since being “subjective” is the worst term of abuse one can ever use when addressing a natural scientist.

The subjectivist’s approach had been attempted previously, most famously by Descartes (1641) and Berkeley (1710), and most recently by Basri (1966) who for the first time succeeded in providing science with its first definition of “objective reality.” Unfortunately he used logic, one of the tools of scientific realism, to prove his thesis and failed for this very reason and his efforts remained, in general, unnoticed. For instance Bunge (1977) smiled scornfully:

For example there is Basri’s (1966) theory. But we rejected it in Sec. 1 for being a particle theory and therefore inconsistent with field physics, and also for being subjectivist, hence inconsistent with the epistemology inherent in the scientific approach. In short, since the theory is subservient to an unscientific philosophy - namely empiricism - it serves neither physics nor psychology... (Bunge 1977, p. 299)

Without hesitation the realist’s doctrine has led science to great successes, however for this very reason, we must not remain blindfolded.

Scientists can only inform us about what is actually happening. The pattern of /action-observation/ cannot possibly be broken. In a sense scientific knowledge is the sum of a myriad of such /action-observation/s collected by mankind into an enormous database. This knowledge is later compiled into a set of scientific models – models fed by a question can provide useful answers – exactly in the same way that we make use of a more ordinary database or expert system. The pattern /action-observation/ repeats in the pattern /question-answer/- and neither of these need a reference to reality to make sense. We can build a database on chess problems – but do we need the concept of a Nature to answer chess problems? No – but of course it is much easier to explain and demonstrate the chess game through the use of figurative chess pieces but this has, however, no bearing on the situation. Do we need the solar system to understand the happenings of the atom? Certainly not – but here also an explanation is facilitated by reference to our daily experience. This is the very core of the problem of scientific interpretation, namely that scientists, and more distant spectators, cannot help but involve themselves in some additional interpretations when investigating science - for science has become an activity of our cultural civilization as a whole. We badly need to understand the phenomena of science in terms of our everyday experiences, otherwise we cannot grasp this knowledge. The need for physical (and in that sense real) analogies are vigorous – and in this process of transformation we “make” atoms into solar systems, we “make” photons into tiny stones and light to emulate the billowy motion of the oceans. Many scientists and philosophers understand very well that this “transformation” is merely an act of naïve presentation - but very few, however, realize that this imaginative “act of ontological solidification of the elements of thinking” is buried deep down in the realist’s doctrine – and indeed in the very core of the Newtonian paradigm.

1.3.6 The aim of science.
Scientific success is measured by the success of its activity and not by the structural resemblance to some everyday phenomena met with in normal life. The stipulated real/imaginary distinction is confusion – as is Cartesian dualism – this is the central theme of this thesis. The main activities of science are prediction and inter-subjective communication and stated, in its most general terms, the aim of these two activities is success. What counts as a success clearly depends on the criterion of success accepted by the paradigm in use, which is also partly inherent in the embracing paradigm of scientific activity. To say what is “really going on in science”, we must therefore try to explicitly determine its very aims in that sense.

Newton understood the aim of science to be the uncovering of God’s design which was latterly reformulated in physics into the quest of truth - as to find the true basic laws of Nature. However when we
assign truth to the laws of Nature this also means that we assign truth to the *very idea of a Nature*. Such a truth attribution implies that the very statement “there is a Nature” is rendered to be “true.” Lacking access to some absolute truth, such a question is decided by means of a decision procedure approved by the scientific community, i.e., its accepted paradigm. That is to say that the statement “Nature is” is part of its disciplinary matrix, which ultimately reduces to the question of the very status of the concept “Nature.” First of all this is a *name* of a phenomenon - an epistemic entity as part of our knowledge - but the crucial question is whether science gains clarity by trying to assign ontological significance to this phenomenon. If not the ontological question is obsolete. This question, however, cannot be answered by one person only – we must rather ask science – and science can give an answer in terms of a consensual decision only and such consensual decision is part of the very paradigm of science. “Is there a Nature?” is a central question in this thesis, and we immediately notice that at one level the answer is in the affirmative. This is so because of the existence of the word “NATURE”, which is the very address to my and your mental domain where the remembrance of this “feeling of Nature” is kept. Through this address we are able to recall the “feeling of Nature” and by such recollections we can find out that Nature is both a complex of feelings and that the meaning of the word “Nature” is known. However the remembrance of such a complex of feelings can be nowhere else but “inside” the mind of a human being – as a phenomenon - and so is the collective they belong to, namely the world.

The mind phenomena are the very objects of human knowledge - we must unavoidably adopt the phenomenological\(^{35}\) approaches as advocated by Mach and Husserl – the latter following the leads given by F. Brentano (1874) – who considered descriptive empirical psychology to be the basis of human knowledge. These ideas had by the 1870’s begun to challenge mechanistic materialism largely as a result of developments in physiology and psychology, which cast doubts on its doctrines of the external world and the ability of scientific theory to adequately describe that world. Mach adopted these ideas and maintained that *science is no more than a conceptual reflection upon facts whose elements are contents of consciousness given to us by sensation.* However in his role as a physicist he failed to recognize that sensations are not all there is to human knowledge – there is human imagination as well – and here is the point where the sensations of experience meet with ideas and theories generated by our present knowledge. In this very meeting all concepts are created and further knowledge produced.

There is a close connection between aim and belief – for the very reason that we never aim at something we do not believe in. When we believe in the real/imaginary distinction - then the aim of science can very well be the quest for a “real-ity” as it has been for some thousand years. Realising that this question is undecidable we must leave this question behind us – but curiously enough the debate around the real/imaginary distinction is still very much alive.

*Quine (1990) defined science as the “pursuit of truth” – and also such a pursuit is in need of a belief in Nature, because “truth” is the outcome of a decision where human ideas (or phenomena) are compared to Nature. Since the aims reflect the beliefs about what is possible to achieve in science, the “pursuit of truth” simply reflects the belief in a Nature. Not only in the very term “Nature” but in a phenomenon – a collection or construction of facts - that can be made accessible to all scientists. However Nature in its sense of a private phenomenon is not accessible to science.*

When we, in the private realm, try to tie the phenomena of our mind to some “common “reality” we must resort to hypothesising. At this very moment “reality” is born as an allusion – a means to make a distinction between the domain of sense impressions and the one of mind’s pure imagination – between “the reality domain of mentality” and “the imaginative domain of mentality.” Certainly not as an ontological one – since the two together make up Berkeley’s immaterialist domain. For this very reason Prigogine (1996) concludes that scientific determinism is lost forever – for the evident indeterminism of a purely imaginary world of knowledge – the only world we know. No awkward loss, since we thus re-gain the lost free will of human beings.

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\(^{35}\) See appendix A
So when Mach instead answered that the aim of science is economy of thought and the organization of human knowledge, we can gladly accept this answer just because it makes reference only to human knowledge. For the same reason that we can accept Husserl’s idea of philosophy as a rigorous science (1917) expressed only through pure phenomenology, as well as Kuhn’s (1962) assertion of sciences as a social activity made up of the general theoretical assumptions and laws and techniques for their application – the paradigms - that the members of a particular scientific community have adopted.

By now we have given an answer to the second question posed in paragraph 1.3.4 – the mental phenomena of human mind are the objects of science (including its eventual sub-phenomena), no matter whether they are considered percepts or imaginations. In such an endeavour, though, we cannot possibly accept the realist’s doctrine with its enforced and bewildering dualism. Neither can we accept the inconsistencies of the classical truth conception made obvious by Tarski and Goedel, and as a matter of fact the idea of a useful truth conception will fade away when we reject the idea of a pre-given nature. Turing (1935) has explored the limits of human decision capability, Chaitin (1998) the limits of mathematics, Bell (1968) the limits of physics, von Foerster those of observation and knowledge and Priogine (1996) has, through his writings, put an end to physical determinism. In that light we have to reconsider present human thinking and its fundamental principles as given by the Newtonian paradigm. However, this paradigm is still in control in spite of the advent of quantum physics. We will soon understand the consciousness puzzle is just a puzzle to philosophers and scientists brought up in the Newtonian paradigm, and this fact is brought out very clearly by the SOA. However, the means to its acceptance seems long, and therefore we will next cast further doubts on the prevailing paradigm of science.

1.3.7 The vain pursuit of truth

We cannot merely accept that the “pursuit of truth” is the aim of science without further ado. We must ask if truth, in that sense, is at all attainable. Neither can we merely pretend that the aim of science is the discovery of a pre-given Nature without asking whether it is also pre-given to human knowledge. We must ask about the status of human knowledge and in what way such knowledge can be regarded as “objective.” Then perhaps we can answer the questions “What is science?” and “What is it good for?” – but then we need to know their aims – and the specification of the very goal of science cannot be left entirely to science. This is the very mission of a community in a sense ranked “above” the sciences, namely the meta-scientists.

Van Fraassen (1991) has dwelled on this issue:

Can we find an internal criterion of success that characterizes scientific activity for all ages, and equally for philosophical and unphilosophical participants? The first thing to do is see exactly what the product is whose success is to be assessed by that criterion. When we focus on the scientific theory, as product of science, we turn this into a question about theories. So, first, what sort of thing is a theory? A scientific theory must be the sort of thing that we can accept or reject, and believe or disbelieve. Accepting a theory implies the opinion that it is successful; science aims to give us acceptable theories. More generally, a theory is an object for the sorts of attitudes expressed in assertions of knowledge and opinion. A typical object for such attitudes is a proposition, or more generally a body of putative information, about what the world is like. (van Fraassen 1991, p.2)

Here the computer scientist wants some reformulations. The term “proposition” should read “statement” or rather “a set of statements” thus compromising a model - and “a body of putative information” we recast into “a paradigm”, and here we presume that they both, in a sense, can express our views “about what the world is like.”

Here van Fraassen first presents:

the answer we call scientific realism. This philosophy says that a theory is just the sort of thing which is either true or false; and that the criterion of success is truth. As corollaries, we have that acceptance of a theory as successful is, or involves, the belief that it is true; and that the aim of science is to give us (literally) true theories about what the world is like (van Fraassen 1991, p.3)

Using the term paradigm we understand the success criterion of science is part of its paradigm – in this case truth in the sense advocated by the correspondence theory of truth. And the crucial question here is: “In what way can an observer and a scientific community decide on such a question?” van Fraassen states that science cannot and, in parallel to Dummett (1978), proposes:

the anti-realist position I advocate, which I call constructive empiricism. It says that the aim of science is not truth as such but only empirical adequacy, that is, truth with respect
to the observable phenomena. Acceptance of a theory involves as belief only that the theory is empirically adequate. But acceptance has a pragmatic dimension; it involves more than belief. (van Fraassen 1991, p.4)

In that sense they both parallel Husserl’s pure phenomenology in claiming that truth can be attributed to the mental phenomena of sense experience only. They obviously mean truth in the sense of a correspondence between a mental impression and its model. But who is going to decide on such a question? Science? No – science as a collective phenomenon has no access to any specific mental impression. If this should be the case, what specific mental impression are we then talking about? Yours or mine - or are they all similar? We cannot embark on this path without losing our way – and this is what has happened to modern philosophy.

To clarify this situation we firstly need to observe that the classical truth criterion, thereby including classical logic, is part of the Newtonian paradigm. Regarding mental impressions we further need to observe that the observing subject is the only person having access to these phenomena – a principle that I prefer to call the primacy of subjectivity.

For these reasons we cannot, as a first option, use the Newtonian paradigm, and its logic, to reject the Newtonian paradigm – we are forced to involve non-Newtonian metaphysics. Secondly, we cannot start from the point of view of “science.” As, since “science” is mostly knowledge based (KB) and as such lacks perceptions, we must therefore use the SOA to build a consistent science.

Also van Fraassen concludes:

The agreement between scientific realism and constructive empiricism is considerable and includes the literal interpretation of the language of science, the concept of a theory as a body of information (which can be true or false, and may be believed or disbelieved) and a crucial interest in interpretation, i.e. finding out what this theory says the world is like. There is much that the two can explore together... both agree, after all, that theories say something about what the world is like. (van Fraassen 1991, p.4)

However, he fails to point out that it makes an enormous difference as to whether the world “is like” a pre-given ontological reality in Popper’s sense or simply a set of models in the sense of computer science, thus being part of a comprehensive paradigm in Kuhn’s sense. He fails to recognize that the “world we know” is constructed from “inside” \( \rightarrow \) “out” and not the opposite as tacitly assumed by the realist’s doctrine. He continues along the same lines:

The content of a theory is what it says the world is like; and this is either true or false. The applicability of this notion of truth value remains here, as everywhere, the basis of all logical analysis.

Here he forgets, however, that logical analysis is a tool developed in the Newtonian paradigm and is called into question at the same time as this very paradigm. This issue was raised early in the 20th century for other reasons by L. Brouwer and has since that time been pursued under the heading of intuitionism, intuitionist logic and constructive mathematics. Van Fraassen goes on:

When we come to a specific theory, the question: how could the world possibly be the way this theory says it is? concerns the content alone. This is the foundational question par excellence, and it makes equal sense to realist and empiricist alike.

What if the world has no ”content” that we can know? What if our knowledge simply is all the ”content” we can attribute to the world? If this should be the case - whose knowledge do we then speak about when we talk about scientific knowledge - yours, Einstein’s or mine? Neither realism nor constructive empiricism can provide us with consistent knowledge in this situation.

I claim that constructive subjectivism – in the guise of the SOA - can provide a useful framework. In any case this approach is in a far better position since it does not take the “content of the world” to be pre-given to the observer – it takes as pre-given only the very first\(^ {36}\) impression (the initial phenomenon) and discusses in which way we can relate this first impression to some other phenomena. From this view the “outside” world is empty – and the knowledge we can extract from our impressions will constitute the “world” – and in this act of construction we take, as our starting point, the first mental impression. This

\(^{36}\) The subject-oriented approach is a boot-strap epistemology
“boot-strap” procedure clears the foundational question par excellence that Descartes (1641) has, most famously, already tackled.

We must set ourselves free from the Newtonian paradigm with its celebrated and confusing ideal of self-assumed scientific objectivity and reject the idea of “physical space” as a precondition of experience. This Newtonian legacy is evident in the following passage by Bunge:

> We must therefore try an objectivist approach, i.e., one starting with factual items as the prime stuff and postulating their relations quite apart from considerations of perception and even measurement. This does not mean that the construction should proceed a priori, i.e., in advance to any experience. Quite on the contrary, we shall be guided by the finding of scientific experience, that physical space is a three-dimensional connected generalized continuum. (Bunge 1977, p. 283)

Here he assumes a given “world” quite apart from perception and even measurement – i.e., pre-given and through this view he equates himself with the objectivist approach i.e., the idea that this world is unary (and thereby possibly can provide a decision frame of scientific truth). He actually, somewhat rashly, claims that “physical space” is an empirical scientific finding and thereby ontologically pre-given. In the spirit of Poincaré (1905) this thesis will advance the claim that space is just a conceptual tool and thus a matter of conventionalism rather than a physical fact as claimed above by Bunge.

Knowledge depends neither on physical space, nor on time but nevertheless we still organise our knowledge by the use of a time concept. This process of organisation (time ordering) goes on from birth at a private level, and as time advances we successively learn to cooperate with other living beings by the use of this time order. One facet of this act of cooperation is the ability to communicate in a synchronised manner with other beings – and we laboriously learn that we can develop a framework to gain mutual understanding by time marking the impressions we experience in life. These acts of modelling and communication are the prime reason that the human race has come to dominate life on earth. These models are the explications of our private knowledge that in turn are shaped consensually by coexistence that provide us with the tools of anticipation and communication. When we cast these activities into well-specified rules and paradigms – to bring forth a coherent group activity – we call such an activity a science and its product scientific knowledge.

### 1.3.8 Today's trends in the philosophies of science

Until late in the 19th century, science was dominated by mechanistic materialism. Here the basic idea was that science was able to present a picture of the world firmly based on empirical inquiry, and not falling back upon philosophical speculations. Regarding this view there was no doubt that a real, “objective” world existed, independent of individual perceivers, which was also composed of matter. Science, at this time, was the discovery of the mechanisms by which these animate and inanimate complex matters came into being and how they behaved. Science produced mechanistic laws governing life and the world – as matter or bodies in motion. Observation of the world was immediate in the sense that no conceptual mediation was involved in obtaining observational knowledge; direct observation yielded knowledge of the world's mechanistic nature.

During that period the developments in physiology and psychology, started to cast doubt on the doctrine of the “external world” and science’s ability to adequately describe such a detached world. One found the activities of the thinking subject must be taken into consideration in order to provide a correct scientific description of this world. Phenomenalism was born and the new task of science, from this view, was to discover the general forms of human perception as structures of sensations; that could explain the “external world” as a web of logical relations as exemplified in sensory experience. Scientific laws from now on described the structures of phenomenal sensations, rather than the structures of the “thing-in-itself.” Since the subject matter of mathematics consists of patterns or structures (sometimes in the form of collections of mathematical objects) the mathematicians could stay outside this change - “structuralism” was still the issue but the sources of these structures changed radically – that was of great concern to the realist’s physicist.

E. Mach (1996) contended that science is nothing other than the conceptual reflections upon facts whose elements are the content of human consciousness – as given to us by sensation or complexes thereof – at the same time maintaining that one must reject any a priori elements in the constitution of our knowledge.

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37 See e.g. Brentano (1874), Helmholtz (1863).
of the phenomena. The private human consciousness was in turn connected to the universe of science by the specification that scientific statements (model statements) must be empirically verifiable. All statements occurring in a scientific theory must reduce to statements about sensations – that were capable of being verified by scientific observation.

Mach is generally credited with initiating the “philosophy of science” and thus challenged the “truth” and “certainty” associated with Newtonian physics and stirred up a revolution in man’s thought – even if this fact is seldom fully recognized. He was subsequently supported by prominent researchers, most notably Einstein\textsuperscript{38}, and by the turn of the century the physical sciences were developing much more theoretically and mathematically. In 1905 Einstein published his special theory of relativity – as an answer to Michelson/Morley’s attempts to determine the earth’s velocity through the ether - and shortly thereafter the quantum theory was well on its way. With the acceptance of the new physics, a philosophical crisis emerged: the new physics was incompatible with the prevailing notions of scientific common sense – the Newtonian paradigm.

Contemporaneously in 1917 Husserl, following the leads of Brentano, introduced:

\textit{A new fundamental science, pure phenomenology, has developed within philosophy: This is a science of a thoroughly new type and endless scope. It is inferior in methodological rigor to none of the modern sciences.}

The very objects of this science were the “pure phenomena” of the human mind that extended Mach’s domain of the “phenomena of sensations” including also the mind phenomena of non-perceptual origin. However Husserl constrained phenomenology by bracketing the question of [reality], i.e., he refrained from trying to connect the mind phenomena to some other domain of human knowledge as for instance the physical reality or the universe of science.

From that moment, the human mind phenomena (mental impressions) was at the centre of interest of all scientific disciplines both in the natural and social sciences. In the Mach/Husserlian approach “phenomena of mind” now became the very objects of interest rather than the “things of world.” The proposed 2-step model of modelling can be used to make clear this state of affairs as this model clearly reveals the dual perception-modelling action involved, i.e., \{reality $\rightarrow$ phenomenon $\rightarrow$ physical model\}. See adjoining figure.

The Mach/Husserlian approach is also used in the SOA, where we previously contended “reality” to be a plain hypothesis and using the schema:

\[ \left\{ \begin{align*}
\text{\small \text{phenomenon}} & \quad \text{\small physical model} \\
\end{align*} \right. \]

and we find that from this point of view “reality” sort of “disappears” and “phenomena” are the only possible objects of interest in any scientific discourse.

Also in mathematics a similar trend towards the workings of human mind phenomena was seen in terms of (the) logic (of human thinking). Frege’s (1892) work and Whitehead-Russell’s Principia Mathematica (1910) was a coherent development of mathematical logic, which also axiomatised much of mathematics in terms of that logic; claiming that all of mathematics can be done in terms of logic, and that logic provides the very essence of mathematics. The world witnessed the emergence of many paradoxes at that time and L. Brouwer (1907) objected most insistently to this idea – claiming mathematics to be the primary. Russell’s ideas were assimilated by the members of the Vienna Circle who claimed that the mathematical statements of scientific laws and also the definitions of theoretical terms could be given in terms of mathematical logic, giving rise to the movement called \textit{logical positivism}; Mach was correct, they argued, in insisting on verifiability as a criterion of meaningfulness for theoretical concepts, but he was mistaken in not allowing for a priori elements of formal character – and now the place for a strict \textit{logico-mathematical conceptual framework} was secured – they believed. Following Mach they stated the subject matter of scientific theories is \textit{phenomenal regularities} and added that theoretical terms are to be \textit{explicitly defined in terms of phenomena} (or a language that makes reference to such phenomena). This is the most famous tenet

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of logical positivism – its famous verifiability principle. Frege’s logic was to provide the framework and the result was the original version of the Received View:\(^{39}\):

A scientific theory is to be axiomatized in mathematical logic (first order predicate calculus with equality). The terms of the logical axiomatization are to be divided into three sorts: (1) logical and mathematical terms; (2) theoretical terms; and (3) observation terms which are given a phenomenal or observational interpretation. The axioms of the theory are formulations of scientific laws, and specify relationships holding between the theoretical terms. Theoretical terms are merely abbreviations for phenomenal descriptions (that is, descriptions which involve only observational terms).

(Suppes, F. 1974)

In a sense one could say the logical positivists made a choice from the multifaceted alternatives of modelling available – the logical model was the correct one to use for “objective” scientific specification. This was probably not the God’s Eyes view in the sense asked for by Putnam (1981) – but this became at least the Scientist’s Eyes view – that was christened the Received View by Putnam (1962).

The Received View tries to avoid the introduction of metaphysical entities in science. Since metaphysical entities are neither phenomenal nor observational entities, the terms used to describe them cannot be observation terms, and so they must be a priori or theoretical terms\(^{41}\). In the Received view, however, theoretical terms are allowed only if they can be provided with correspondence rules which give them an explicit phenomenal definition – and accordingly metaphysical entities cannot be introduced into scientific theories. In this way they intended to stop the frequent occurrence of loose metaphysical speculations. However the ban on metaphysics also means that the place of physics within science cannot be properly discussed and, in a sense, logical positivists almost equated science with physics. They claimed metaphysics to be mainly a verbal ornament – and speaking ironically - bare attempts to bring about some feelings of high-pitched-ness to the speaker.

For a little while it seemed that the meaning-restoring device would be very simple – and Bridgman (1927) tried to provide such a dictionary or set of “operational definitions.” By its use, the language of theoretical physics would receive a complete translation into the simple language of the laboratory assistant's observational reports. Instead of conceiving science as describing things, their properties and behaviour, it must now be treated as describing the operations we perform in the laboratory and in the study. “Length” then ceases to be a property of a thing – it is rather defined as a set of operations using a sliding ruler. The slide rule now becomes the a priori axiom – however this criterion about meaningfulness was too restrictive and Bridgman subsequently changed his mind allowing for an indirect connection between theory and observation. Another serious problem is that the rule is still “outside” the observer’s mind and human decisions are unavoidably made in the mind.

The Received View was subject to a number of modifications as defects were discovered; but these changes did not affect the basic doctrine of positivism, which construed theories as partially interpreted axiomatic terms, hence as linguistic entities. To say that something is a linguistic entity is to imply that changes in its linguistic features, for instance its reference or the formulation of its axiom system, will produce a new entity. Irrefutably a change in the axioms of a theory is a change of theory and the Received View continues to be a shade of physicalism\(^{42}\) throughout its philosophical life.

So the Received View is very dependent on the axiomatic method – and the blow dealt by Goedel (1931) was devastating and despite certain undoubted successes, the linguistic turn in analytic philosophy became a burden to philosophy of science. The reason is buried in the human use of language especially sentences and words. Words are constructed out of meaningless symbols – the symbols a, p, and e have no special meaning in isolation – nor when concatenated into “ape.” However the very moment this word-structure is presented to me I am able to make an “interpretation” – i.e., make a connection between the word and an image of remembrance. I thereby give the word “ape” a meaning – however such an image of remembrance is, by the virtue of the primacy of subjectivity, strictly private. Thus giving a “meaning” to the axioms of a language is a strictly private endeavour (i.e., subjective or non-objective) and this poses a major

\(^{39}\) The term “received” refers to the receipt of mind (i.e., the phenomenon)

\(^{40}\) That also was the presumed foundation of mathematics

\(^{41}\) This distinction was later attacked by Quine in the “Two Dogmas of Empiricism”

\(^{42}\) The doctrine that all phenomena can be described in spatiotemporal terms and consequently that any descriptive scientific statement can in principle be reduced to an empirically verifiable physical statement.
problem for science to find a group consensus on that issue. H. Putnam (1981) provided a devastatingly logical critique of this lack of meaning in the objectivist’s paradigm that is comprehensively dealt with in Lakoff (1994).

Van Fraassen (1980) accounts for further developments noting that during the Second World War, E. Beth became increasingly dissatisfied with the discrepancy between science and philosophy and suggested that a philosophy of science, “instead of attempting to deal with speculations on the subject matter of the sciences, should rather attempt a logical analysis - in the broadest sense of this phrase - of the theories which form the actual content of the various sciences.” This is to consider that the mathematics in use are a fundamental abstraction in human conceptualisation independent of the science that uses it, i.e., consider mathematics to be the principal language of meta-modelling - and leave the construction of other conceptual languages along the formalist line to the discipline in question – an approach proposed by Carnap (1934).

The first to try to turn the tide was P. Suppes who suggested that the correct tool for the philosophy of science is mathematics, not meta-mathematics. It is unclear whether he meant that the prevailing metamathematics, i.e., logic was an improper tool for such a use (that both Goedel, Tarski and Turing earlier clearly had indicated thereby confirming the ideas of Brouwer) or that it was just a concession to contemporary mathematics, where Suppes had found his inspiration:

This happened in the 1950s; bewitched by the wonders of logic and the theory of meaning, few wanted to listen. Suppes's idea was simple: to present a theory, we define the class of its models directly, without paying any attention to questions of axiomatizability, in any special language, however relevant or simple or logically interesting that might be. (van Fraassen 1991 p.6)

This new tradition was called the “Semantic Approach” or “Semantic View on Theories” and was offered as an alternative to the Received View on Theories. Further developed and later documented under the name of the Semantic Conception, it was claimed be one of the many factors in the demise of the Received View.

Using this view, a science starts out with a definition of its models, i.e., with its presentations – and this approach, at a stroke, places Semantic Conception side by side with the Received View: The observer function of the scientist is aborted on a primary plane – and he/she cannot understand the science he/she is doing for this very reason. This is of course also the reason both the realists and the empiricists can use the same “semantic view” because the question: “Is the world real?” is swept under the carpet by the loss of the first step in the 2-step observation-modelling schema. Van Fraassen correctly concludes the development of the Semantic Conception and the debates over scientific realism have become intertwined, and one cannot go very far developing the former without confronting the latter.

The choice between the semantic approach to science and its rivals is entirely independent of the controversies between scientific realism and anti-realism. As Giere (1988) and Hacking (1983) especially have emphasized, scientists in the throes of empirical research express themselves just as would true believers in the reality of the entities postulated. We do not need to take this way of talking as necessarily indicating a point of view embodied in the very enterprise of science-many famous scientists appear not to have done so, and I certainly do not. But the semantic approach would start with a severe handicap if it embodied a particular stance on such questions. (van Fraassen, 1991 p.15)

The use of a 2-step model makes this problem much easier to handle since the phenomenon’s relation to an eventual “reality” is taken care of in the first perceptual step and the problem of how to publicly explicate the phenomenon is deferred to the second step. The 2-step model also gives us a reason to believe that F. Suppes is in error when claiming a sharp contrast between the Semantic and Received View:

According to the Semantic Conception of Theories, scientific theories are not linguistic entities, but rather are set-theoretic entities. This is in sharp contrast to many versions of the positivistic Received View on Theories, which construes theories as partially interpreted axiomatic terms, hence as linguistic entities. (F. Suppes 1989 p.3)

In that sense however set-theoretic entities are not different from linguistic entities - they are also in need of axiomatic terms – the change of which will also change the set theory in use. This insight brings us

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43 Because of the primacy of subjectivity
44 See collected paper No 1 “An Intuitive Approach....“
back to the time of Mach and the idea of refusing the use of a priori elements in science. Considering this point however, we find ourselves seemingly caught in a trap – because without the use of some sort of axiomatic elements human modelling is impossible and as a consequence also human communication. Scientific modelling (=communication) inevitably calls for some sort of axiomatisation. We must conclude that we, by our choice of specific basic modelling element(s), specify the properties of the conceptual framework (language) used for modelling – and thereby put restraints on the descriptions (communications) possible. For that reason it seems multifaceted modelling is a necessity to scientific communication, i.e., a certain phenomenon must be portrayed by a set of models each one specifying certain traits of the phenomenon.

We know, on the other hand, that human observation is also theory-laden, i.e., is driven by the conceptual axioms we force upon the world and these axioms are very likely dependent on human perceptual capacity. In that sense human beings and their perceptual apparatus give rise to the appearance of the "things of the world" as conceptions/imagination mainly - constructivism.

It is fairly easy to understand that the only difference between the Semantic and the Received View is the choice of a conceptual framework of modelling. The Received view depended on Frege’s logics while the Semantic View started instead from the set theory of mathematics – and in that respect the supporters of the Semantic View take the position in favour of Brouwer and the intuitionist school of mathematics in claiming mathematics is primary to logic.

However an answer to this question does not settle the dispute between the realists and the instrumentalists – because if there is a difference between these two views this difference comes out in the first perceptual step process of observation. However Carnap and Dummett (1978), most famously, claim no human observation can make a decision in this matter – that amounts to saying that experiential physics is unable to provide an answer in this case. This is rather a question of a super science of physics, i.e., metaphysics - that unfortunately cannot take a firm hold in human perceptual experience.

Regarding the mind phenomenon as the “instrument of decision” of human knowledge – we understand the Received View is a facet of instrumentalism as is the Semantic View. For this reason it seems a bit alarming that the Semantic View can also supply a basis for a realist interpretation other than the anti-realist one van Fraassen himself favours. This question also brings about another one: How come scientists so desperately cling to the idea of scientific realism? To answer that question van Fraassen points to scientific practice. The scientist's practice is essentially to pose a question, "Why P, rather than Q?" against a background of accepted, often tacit, presuppositions. (van Fraassen, 1977) and this is no doubt a question of categorisation. Since physics has mainly by habit, become the “science of the real” - not on the grounds of some clear ontological definition but rather on the grounds of the physicist’s peculiar habit of extending the “domain of the real” in parallel with the discoveries – P and Q in consequence most often refer to real things. The rise of quantum physics then pinpointed this dilemma. The classical functioning physics – the Newtonian paradigm – made use of a background in which the reality of quarks, particles, atoms, molecules and so on are considered “pre-given” because they are the “real objects of physics.” In the next moment, they are denied a real existence by quantum physics – and are instead likened to a wave of probability or some other purely imaginary phenomenon and for this reason we have no clear definition about what is real (also avoid the question whether such a definition even is possible) and so the whole situation becomes very confusing.

Against this background both Quine (1953) and Sellars (1963) in the middle of the 20th century developed highly influential neo-realist positions centring around the doctrine that accepting a scientific theory in practice means to accept the physical existence of the entities posited by the theory. According to this view theories account for the observable phenomena by postulating other processes and structures not directly accessible to observation. This means that a sort of underlying “non-real” system of hypothetical objects is presented by such a theory as the basis of its observable (physical) states. If we then accept the idea that scientific theories are “true” theories – we also, as a consequence, accept the hypothesized objects as “true” – and real. What else is there to be “real”? However here we meet with deep disagreements:

In the heyday of logical positivism and latter-day pragmatism, instrumentalists tended to rely on the form that rational reconstruction of a scientific theory should take. Realists, on the other hand, would point to functioning science and insist that in a developed theory basic category terms are intended to refer to real objects and events, while theoretical laws are intended to be true in a correspondence sense about those objects, albeit approximately. More metaphysically oriented realists insisted that such laws, when true, express some sort of de re necessity and that this necessity can only be adequately explained by real essences.
Instead of tackling the fundamental issues at the time of the decline of logical positivism, some theory-dependent ontic “realism” was developed by Quine and Sellars, and became the reigning realism - heavily backed by Popper (1977). Ontology is introduced here mainly as a pragmatic theory of acceptance in this guise: One who accepts a theory as explanatory should also accept the entities postulated or presupposed by this theory as “true” – and therefore real.

It appears that the lesson learnt by quantum mechanics was sadly forgotten: Science has never been observer-independent and cannot be. This means that what is “pre-given” (or “prior to observation”) is not accessible by direct inspection. If there are “real” phenomena according to some deity - this “reality” cannot possibly be directly mirrored in human knowledge - Rorty (1980). Epistemologically the real/unreal distinction is void and ontology is nullified. This was what Kant and Carnap meant by proclaiming the demise of metaphysics – a physical science is unable to present a “proof” on the “reality” of things. This inability is inherent in the realist’s physics – but not in the instrumentalist’s. This claim is central to this thesis. The instrumentalist takes the compelling absence of a “proof of reality” for the bright intuition announcing the reconstruction of science. However, not even the convinced instrumentalist is able to reject the real conception – but by nullifying the real/unreal distinction he/she is in the position to build a monistic science that is consistent and methodologically sound and avoid the pitfalls appointed by Putnam (1981).

Bohr’s Copenhagen interpretation and Bell’s theorem (1964) meant further difficulties for the realist’s view and recent writings by van Fraassen, Rorty, Sneed (1971), Stegmuller (1976), and Suppes manifest a growing reaction against the reigning realism and initiated a redevelopment of instrumentalist theories of scientific explanation. What remained seemed to be the ideas of pragmatism as introduced by Peirce, James and Dewey (1933) – and foundationalism as espoused by Chisholm (1957) who claimed that knowledge of the world rests on a foundation of indubitable beliefs from which further propositions can be inferred to produce a structure of known truths – most often mentioned as the adverbial theory. In this theory, he sidesteps the use of objects and the problems such as whether they are physical or mental or somehow neither, that they bring with them. Instead, it is suggested, merely a mental act or mental state with its own intrinsic character is enough to account for the character of immediate experience.

In the 80’s we experienced another backlash of realism – see Rorty (1982) – a movement that was immediately countered by renewed interest in consciousness studies. The physicist H. Stapp (1993) has, following the lead from W. James, proposed a realist’s theory that transcends the Newtonian paradigm, also taking the problems of consciousness under consideration and Penrose (1994) presents a realist’s theory of consciousness that is based on a reformulation of Schroedinger’s quantum theory.

The present situation is this: the Received View has been rejected, but no proposed alternative analysis of theories enjoys widespread acceptance and this situation is valid for science as a whole. For more than 80 years science – and not only by the philosophers - has been engaged in a search for a new philosophic understanding of scientific theories; it still is searching to this very day.

1.3.9 The new developments in physics and traditional philosophy.

The physics of the 19th century was built on the Newtonian paradigm – the pre-given and common physical universe was seen as deterministic mechanical clockwork, the evolution of which could in principle be predicted with mathematical exactness. The developments in thermodynamics and Maxwell’s theory of electrodynamics confirmed these ideas but the wave theory of light gave rise to new questions. What was the medium of propagation and what was the essence behind the light sensation? We now understand the earnestness of the Machian decree: All statements occurring in a scientific theory must reduce to statements about sensations – that could be verified by scientific observation.

Planck was, in 1901, seeking to explain hot body radiation and postulated the burst of energy in the form of light quanta a theory that was soon confirmed by Einstein’s (1905a) interpretation of the photoelectric effect. This idea combined with Rutherford’s picture of the atom, further developed by Bohr, gave rise to a “new” physics – quantum physics. A. Scott (1995) provides a richer background on this issue.

It took some time for these new ideas to gain a foothold and for the next serious attempts to try and mathematically incorporate the quantum ideas in classical physics. Heisenberg and Dirac showed this was not possible and de Broglie paved the way for Schroedinger’s (1926) wave equation that some months later
was given an interpretation by Born (1926). The new quantum mechanics was non-objective in the sense that the phenomena observed were not unaffected by the observer any more, which meant that one of the tenets of classical physics was violated in the quantum realm: the detachment of the observer. However claiming that quantum physics was subjective in that way is mostly an exaggeration. The process of observation affected the outcome of the experiments – this meant a new experimental methodology. However, a science defined from the perspective of the observing subject would not have been surprised by such findings. Newton’s science was not and therefore the surprise, which was even more shaken by Heisenberg’s (1927) discovery of the principal limits of human observation - was completely crushed by the classical ideas of scientific determinism.

Science has adjusted to a non-deterministic thinking but the lost objectivity is still not overcome and the idea that the observer/experimenter and the theories he/she holds is part of the outcome of the experiment is an idea alien to classical physics – and the Copenhagen interpretation was met with imprudence and hostility – the idea that knowledge is generated only by means of the observer’s private act of observation was not ripe for scientific acceptance. There was no theory to explain how the “objective” Schroedinger wave function collapses into “subjective” knowledge by means of human observation – and seventy years later there is still no such theory.

Following the leads from Mach the subjectivistic approach has been tried in physics by Whitehead (1919), Nicod (1923), Bridgman (1927), Russell (1927), and Eddington (1933) - independently of Carnap’s similar attempt (1928) – which tried to build physical geometry out of common sense psychology. Laterly we find Basri (1968) and more recently Lucas (1973). The subjectivist’s approach involves a different and observer-centred model of perception, contrary to the mathematically inspired mapping process that is generally adopted by classical science. The underlying model of perception, reminds us that the individual’s phenomenal world is private to each human being. In this model each observation results from the interaction of the observer with the observed; each observation is observer-dependent and unique. In the case where the observation is sufficiently repeatable, however, inter-privacy can be established by agreement and inter-private agreement requires merely that their experiences are sufficiently similar to be taken for ‘tokens’ of the same ‘type’.

These subjective approaches are all phenomenalist’s parallel to the Berkeley-Mach program and they differ in opinion regarding what are the ultimate constituents of human knowledge. Berkeley takes the phenomenon of percept as the ultimate, which is very close to the Machian sensation-complex phenomenon. Whitehead (1919) assumes that space is Euclidean and tries to define in experiential terms all the concepts that Euclidean geometry takes as primitive – he proposes "the deduction of scientific concepts from the simplest elements of our perceptual knowledge" and by considering the event to be primary science resorts to a plain process description. He avoids dualism by pointing out that physics does not describe a “real” world at all – but rather abstractions in the form of experiential processes and their properties. Nicod's (1923) venture was more radical because he started from (imaginary) experiences and attempted to build geometry out of them without imposing any a priori structure on space – in the vein of Mach attempting to build physical geometry out of (common sense) psychology. Carnap made a similar attempt that was heavily criticized by Quine (1951) on the grounds of the void observational/theoretical distinction.

Basri’s work (1966) is rigorous and respects the rules of relativistic physics but is derived using classical logic, which is a work tool of classical (non-subjective) science and therefore inconsistent in a subjective domain. Nevertheless he almost accidentally presents the seed to the workable “ultimate phenomenon” of new consensual science – the subjective entity – which in the SOA develops into the conceptual schema model.

Bridgman and Eddington try to solve the problem of the doubtful status of the objects of science by grounding science upon the operations we perform in the laboratory and in the study. Eddington’s approach is very radical and “instrumental” as he views the numerical readings of the measurement scales as the fundamental phenomena. These two attempts are very useful in a subjective domain – but unfortunately they are both mislead by the classical idea of objectivity and are inconsistent in their attempts to try to “externalise” all the operations of science. Lucas’ more recent attempt (1973) is subject to a similar criticism.

However they are all both novel and radical and all make serious attempts to adjust the thinking of science along the lines of the new discoveries of quantum physics – proclaimed by its inventors and the

46 See Jammer 1974.
47 See paper No 3 - From descriptivism
Copenhagen interpretation. These attempts were sadly in vain and the crowd of objectivists simply refused to listen:

Because of that a priori element Whitehead's theory of space and time is incompatible (by design) with the two theories of relativity and therefore hopelessly obsolete at birth and beyond repair. And because of its pronounced subjectivism the is inconsistent with the epistemological outlook of science, which is realist and the one adopted in this work. As a matter of fact he [Nicod] delivered nothing of the sort: he did not even produce a theory of any of the perceptual spaces such as the visual or the acoustic space. (Neither he nor Whitehead realized the differences between physical space and the perceptual spaces.) Like Whitehead’s, Nicod’s was a scientific and philosophic failure. … Finally the most recent work along the Mach-early Russell-Whitehead-Carnap line, namely Basri’s (1966), is just as subjectivistic on the other hand it has the merit of being admirably rigorous and of respecting the formulas of relativistic physics. However, it does not serve as a foundation for the latter because it violates the spirit of the relativities, which are field theories (Basri admits only particles) and moreover observer-invariant ones (Basri’s is observer-bound). And although this theory professes to be concerned with human observers their sensations and operations, it makes no contribution to the physiology or the psychology of space and time perception. In short, the theory is subservient to an unscientific philosophy - namely empiricism - it serves neither physics nor psychology.

The subjectivistic approach cannot yield what we want in scientific ontology, namely an objective chronotopics compatible with physics but soft enough that the physicist may shape it according to his theories and, whether subjectivist or merely conventionalist, the a priori approach to the geometry of physical space is unphysical because it assigns space a structure independent of the actual distribution of things. We must therefore try an objectivist approach, i.e. one starting with factual items as the prime stuff and postulating their spatiotemporal relations quite apart from considerations of perception and even measurement. (Bunge 1974 p.282-3)

This citation, which in style by no means is unique, shows the strong streaks of religious conviction that often are hidden behind well-formed statements and slogans hurled out in disparaging terms by realist scientists and philosophers. This citation has, in spite of its tone, also one merit since it in the three last lines appositely captures the classical OOA contained in the Newtonian paradigm - “starting with factual items as the prime stuff and postulating their spatiotemporal relations quite apart from considerations of perception and even measurement.”

The rear-view mirror reveals that much more efforts has gone into defending the classical scientific view than trying to assimilate the new physics and its far-reaching consequences to science. As quantum physics is reinterpreted in classical terms on a daily basis – and the physicists just go on inventing new objects that are truly unobservable presenting these new inventions as the discoveries of elementary particles or the essence of matter in the form of vibrating “super strings.” I do not mean to say this is totally in vain just to point out these inventions are the bare models of instrumentalism – and reiterate the real/unreal dichotomy is a misconception. As a matter of fact realism is just another name for instrumentalism - which one can use perhaps to explain how we come to use the void real/unreal dichotomy. We will see by adjusting the base postulates of realism it can successfully merge with instrumentalism into scientism – and consistent scientism hopefully.

The realist/instrumentalist struggle is wavy – Bell’s theorem was a setback of realism – that nevertheless came back and today appears in the form of a superstring theory. However this is primarily a choice of terms to discuss:

Functioning physics so presupposes the reality of particles, atoms, and molecules that a reconstruction which omits and then denies them is like Hamlet without the Prince of Denmark. Such an acceptance does not, however, settle the question of what it means for anything to be real. It would be consistent with the position presented here to hold that physics depicts a phenomenal world in Kant's sense. (Mackinnon 1979 p.529)

What is more important to understand is that the new science must start from the observing subject and its experience and not “one starting with factual items as the prime stuff and postulating their spatiotemporal relations quite apart from considerations of perception and even measurement” as suggested above by Bunge.

These insights came very early in traditional philosophy and following the lead of Plato, Vico in Scienza Nova became the most important forerunner of the historical view known as historicism:

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48 Green 1999.
49 Croche 2002.
the idea that history is the key to any human science. He claimed the world must be understood from “the subjective inside” and challenged Descartes’ preference for a natural science of deductive logic based on clear and distinct ideas. Vico stressed that history is the expression of human will and deeds and can therefore provide more certain knowledge about humanity than the natural sciences can – and as a matter of fact Kuhn made use of these ideas in the 20th century to understand science as a process of knowledge acquisition. In that sense Vico is also an early forerunner to the hermeneutic tradition arriving by itself in the 20th century - Heidegger, Gadamer and Riccuer – and the praised source of inspiration of von Glaserfeld50.

Another path of development of philosophy originated in Brentano (1874) which took an interest in the human psychic phenomena and its internationality, thus paving the way for an all-embracing metaphysics as presented by Meinong. He claimed that it deals with everything thinkable, whether or not it actually exists: it is concerned with “the totality of the objects of knowledge”51 and later into Husserl’s phenomenology it kept this very metaphysics by bracketing the question of reality. On the grounds of its interest in phenomena Husserl’s approach also came to be object-oriented - a weakness Heidegger52 most famously pointed out. He rather concentrated on the question was it meant to “be” as a subject - or a Dasein – which is a process abstraction in the sense advocated by computer scientists.

After Mach, traditional philosophy split into several branches – the philosophy of science becoming more or less identical to the philosophy of the natural sciences that in a sense was set free from traditional philosophy. In the 20th century it firstly took the form of logical positivism - a philosophy, which emerged from the Vienna Circle, and Reichenbach's Berlin School, whose memberships consisted of scientists, mathematicians, and scientists turned to philosophy. This movement first assumed its distinctive features in the work of Comte53, who also named and systematized the science of sociology. It developed through several stages and is best known in the form of logical positivism, and finally, in the mid-20th century very much inspired by the writings of Wittgenstein, it flowed into the movement known as analytic and linguistic philosophy.

The basic affirmations of positivism are (1) that all knowledge regarding matters of fact is based on the "positive" data of experience, and (2) that beyond the realm of fact is that of pure logic and pure mathematics. On the critical side, the positivists became noted for their repudiation of metaphysics; i.e., of speculation regarding the nature of reality that radically goes beyond any possible evidence that could either support or refute such transcendent knowledge claims. Strict adherence to the testimony of observation and experience is the all-important imperative of the positivists. Carnap (1956) and Hempel (1952) have given positivism its most rigid and extensive developments.

Putnam, Quine and others have urged the rejection of logical positivism for two main reasons: its strong dependence on a meaning-theory and its entangled observational/theoretical distinction. Sellars' attack on "givenness" and Quine's attack on "necessity" are the crucial steps in undermining the possibility of a consistent science based on the Newtonian paradigm. The holism and pragmatism common to these philosophers - and shared later with Wittgenstein (1953) and the physicists Wigner and Bohm (1980), are the necessary new lines of thought, which de-objectify the endeavour of science as Kuhn almost accidentally did. Kuhn’s historical approach to scientific knowledge acquisition has obvious parallels:

From this perspective, the common message of Wittgenstein, Dewey, and Heidegger is a historicist one. Each of the three reminds us that investigations of the foundations of knowledge or morality or language or society may be simply apologetics, attempts to externalize (why not externalize?) a certain contemporary language game, social practice or self-image. (Rorty 1980 p.9)

Kuhn’s critics have helped us understand that there is no need of correspondence to reality to establish a consensual science or at least that this question is of subordinate importance – but the crucial point lies in the understanding of the limitation imposed by the primacy of subjectivity – which means that the “language game, social practice or self-image” cannot be externalised as proposed by Rorty above – it must be internalised in the private mind.

50 http://www.umass.edu/srri/vonGlasersfeld/
51 Meinong 1904, in Chisholm 1960 pp. 78-79.
52 http://www.webcom.com/~paf/ereignis.html
Taking the stance that the human body is the medium that can accomplish this “internalisation” we come fairly close to the ideas advocated by Merleau-Ponty. He is a Continental follower of the phenomenological tradition that takes hold of the idea that human knowledge is mediated by the perceptual body which in a sense connects phenomenology to cybernetics by means of the works of Maturana/Varela and in modern times have inspired the conception of the Embodied Mind. In spite of the strong Buddhist influence this work is nevertheless basically object-oriented as is the work of Lakoff and Johnson (1999) where the Merleau-Ponty’s (1962) vision of phenomenology is also very prominent. This view is representative of the cognitive/linguistic tradition that, at the beginning of the 1990’s, gave rise to the pronounced interest in consciousness studies a branch of which has received a special interest from the community of physics under the name of quantum consciousness. This is not a surprise since human modelling and thinking is can certainly not be separated from consciousness studies and this remark in a sense closes the circle back to scientific modelling.

The game of life – which is a private phenomenon only – ceases to be a pure solipsistic game the very moment we can connect this game to the phenomenon we call the “world.” By such connection we give this game - and any other game – meaning. This meaning-connection is subjective, i.e., private and cannot be mediated by other means than conceptual modelling.

1.3.10 Two different approaches to human knowledge building.

Following Bunge (1967) we find, in the history of science, that there have always been two approaches to the problem of building models of the presumed world; the subjectivist’s and the objectivist’s one. In the former, one takes the cognitive subject and his/her experience (the mental impressions) as the point of departure, whereas in the second case one proceeds from a consideration of the “worldly things” themselves and a postulation of their existence, no matter whether this state of affairs is clearly articulated or not.

One is easily led to think that the naïve man’s view is the equivalent to the subjectivist’s view, since every living being from birth is locked up in the first person’s perspective (FPP). This is not the case, however, because the naïve man generally makes use of the objectivist’s view since he, from birth, rather learns to take “furniture of the world” as given to him in perception, i.e., pre-given This thing-like furniture, sometimes called the macroscopic world, is palpable and offers resistance to change makes up the core of the naïve man’s view of the surrounding environment, which is, inspired by the senses of touch, passed on to us by heredity from our Stone Age ancestors. Furthermore this is also the viewpoint prescribed to scientists by the traditional Newtonian paradigm, and through this view man’s attention is directed towards the "things of the world" that in addition are taken for granted by this immediate and almost tacit postulation. Since the objects of perception, from this point of view, are considered “pre-given” to the senses of perception and human knowledge we prefer to call this approach the "object-oriented approach.” In order to isolate this recommended approach classical science in its methodology has commanded the use of the third person’s perspective (TPP). For this reason personal subjectivism has since long been regarded as unscientific and detestable, but we will in due time understand that scientific subjectivism has very little to do with personal subjectivity. Instead of placing emphasis on the object of cognition as the centre of interest – as is the case in the OOA – scientific subjectivism re-directs the interest to the very subject involved in cognition and to its experience. This is, as a contrast, a subject-oriented (or agent-oriented) attitude which we call the SOA.

These two above-mentioned approaches differ in their view of what is regarded to be “given” to human knowledge: Are there some pre-given things (objective) as in the OOA or is the primary category the totality of mind’s phenomena (subjective) as in the SOA? Thus the first claim is that there is a choice as to what is the prime stuff of observation, i.e., what are the objects involved in the first “perceptual” step of meta-modelling (the prime objects or axioms of science) has a profound influence on the process of human observation and conceptualisation, a state of affairs that profoundly influences the build-up of scientific knowledge. The natural attitude as reflected by the OOA has had a deciding influence on the rise of scientific realism, a doctrine that takes its stance from the "real" objects of the world, i.e., the things of the world that are "pre-given" to human observation. From that viewpoint "real" objects are also firm and tangible allowing for the sense of touch to separate a "real" object from an illusory one, which makes the terms "real" and "concrete" appear somewhat similar. However they do not coincide for the same reason that we can say that

55 http://listserv.arizona.edu/lsv/www/quantum-mind.html
thoughts and light are "real" but not "concrete" and this pinpoints another problem when discussing realism - the "real" concept is uncertain until the point of total confusion. Niiniluoto (1999 p.1) rightfully points out that "realism" is one of the most overstrained catchwords in philosophy", and this conceptual confusion tends to contaminate all discussions where the term "real" is part of some dichotomic relationship such as e.g. real/unreal, real/abstract, real/illusory, real/mental and so on.

This state of affairs totally confuses the realist-antirealist debate, and we are forced to admit that both "realism" and all the other above-mentioned dichotomies have been given a curious status in contemporary philosophy. In spite of the prevailing philosophical practice neither scientific realism nor science can be adequately discussed in such a state of conceptual confusion. We will therefore attempt, in this case, to avoid detailed discussions of the conceptual confusions and instead focus on examining the complementary object-oriented and subject-oriented approaches. At the same time we will provisionally compile the above-mentioned dichotomies into a single one - namely the real/unreal distinction – because unreal, illusory, mental, non-tangible or imaginary phenomena are all in some sense "abstract." As a concession to current usage we will occasionally make use of the above-mentioned terms but using them to be synonymous with "abstract." In short, in this approach we take neither the "real" nor "reality" as givens to human knowledge and conceptualisation, we only propose that if there is some phenomenon to be called "real" we will call its opposite "abstract" and as a first step we allow the other above-mentioned dichotomies to be included under the real/abstract distinction.

One should also note that it is widely agreed that the real/abstract distinction is of fundamental importance to science, even though there is no standard account regarding how the distinction is to be explained. In spite of that the realist - anti-realist debate, mainly fuelled by the logical positivists and Dummett, has been an important battle during the 20th century, engaging not only the philosophies of science, but indeed most scientific disciplines. It still does so and the most perplexing feature of this situation is that the sworn realist in general begins the defence of scientific realism by taking this distinction for granted and furthermore often proceeds without even providing a definition of the term "real" or other attempts to separate it from other more abstract phenomena. There is actually a reason to claim that the situation is worse, as it is not at all clear as to whether the real/abstract distinction is a useful scientific distinction. We might possibly know how to classify things as real or not by appealing to "intuition" but unless we know what makes a phenomenon real, we cannot know what (if anything) is involved in the classification. It is in this light that we must regard the claim, e.g. in Collected Paper No 5, that there is no other choice but to regard mental impressions as the ones which contain the prime facts of a consistent science, while doing otherwise is to produce confusion.

The object-oriented and subject-oriented approaches also differ in their view of the role of human observation, since the OOA claims human perception to be observer-neutral, i.e., independent of the individual making the observation and his means and theories of observation, whereas the SOA contrariwise maintains that observation is both theory-laden and heavily dependent on the perceptual capacities of the observer. In short the two approaches make use of different models of human perception, which will, as we shall see, result in a different validity of scientific knowledge. In the coming section we will further scrutinize the foundations of these two approaches to scientific knowledge build-up and point out that the clear-cut distinction of these two approaches also makes it possible to understand the confusing diversity of – isms that flourish in contemporary philosophy.

### 1.3.1.1 Summary

We propose a science to be:

**the activities of collection and organisation of human knowledge – and its subsequent application**

The **application phase** discloses the following structure:

[question → model → answer]

where the **model** is the bulk of collected and organised knowledge of science that is of crucial use both to the individual and the groups called scientific communities. The means and principles of knowledge organisation will be dealt with in the coming sections.
In conclusion the question we raised at the beginning of this section: “Why science?” is answered by the need of **prediction and explanation** in all its shades of practical use in human life. **Prediction** in order to cope with tasks of everyday survival defines the very goal of each individual and a group and accordingly science. The **how-question** of scientific methodology receives an answer through the **rules of knowledge acquisition stated and as such embedded in the scientific paradigm**. Firstly we have knowledge creation at a very **private level** where this paradigm is tacitly established by our culture and the way we learn to handle the task of living. This paradigm is part of our tacit knowledge and more or less unconscious and therefore needs to be brought out into the open. Secondly, since science is a **group activity**, the paradigms ruling these group activities ought also to be brought out into the open and specified in an unambiguous and understandable manner. They seldom are, however, to the great detriment of science.

At the level of group activity **explication** (communication) defines an important means of achieving the group consensus needed for effective co-operation, the very goals of science. In the individual case we can do without such a process of explication. However, such processes are nevertheless of great importance to the individual because they create a structure of memorisation.

The Newtonian paradigm specifies that progress in the **natural sciences** proceeds mainly through **scientific experimentation**. It is well-known that this activity is supported by a comprehensive set of theory and practices that specify how to set up an experiment, how to collect and later organise the human knowledge acquired through this presumed “real” world. In general such experiments involve both the production of the “real” objects under investigation (e.g. electrons or light quanta), and instructions for “reality” organization (in form of specifications of the physical experimental set-up). The subsequent **phase of experimentation** is also organised in the sense that there are given specifications regarding what to observe and how. Later on the set of collected data are tidied up through several steps of evaluation in order to provide the answer to the question initially posed. We can say that the classical experimental procedure is wholly permeated by the Newtonian paradigm. Fig. 1.

An **abstract (general) science**, on the other hand, is a theory of how to collect and organise human knowledge concerning the mental “world”, i.e., the phenomena of mind - by way of **mental experimentation** if one prefers. Such an “experiment” involves instead a process of ”abstract thing” production (i.e., thought production) and ”mentality” organization (in form of specifications of the intellectual set-up of thinking). This implies setting up a mental experiment with some mental objects, and giving them some specified initial values in a certain mental experimental context. The subsequent phase of thought experimentation must also specify specifications about what to observe and how. Later on trains of thought are also involved in this process, tidied up through several steps of evaluation in order to provide the answer to the question initially posed. Notably, unlike the situation in the Newtonian paradigm, the succeeding realization of this mental experiment, in this case, comes very close to that of a simulation experiment (often simply called simulation), but in the case of mental simulation we do not make use of a computer to find a solution – but rather our brain. Fig. 2.

The production of such ”mental objects” means to **think of them** (or produce them in some other fashion), i.e., **sign production** and thereafter we place those signs as markers in some suitable experimental structure (e.g. a computer or a human brain). Then follows the subsequent abstract experiment – or computation.

When we, in this manner, recognize that both physical and mental phenomena are signs – and signs only - to be treated at the same level of experience, then we no longer need to make a distinction between a real and imaginary sign (phenomenon). From this viewpoint, the natural and abstract sciences conflate – as do the real and the abstract models of science. **Human science become the science of signs (phenomena)** – and the painful question about the essence of signs is irrelevant. Since the distinction real/abstract is

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56 Each branch of science has its own paradigm
unnecessary we can say that "knowledge is (the signs of) knowledge" that belong to a single knowledge domain. Considering the Natural world we say it is “as it is” – i.e., unknowable, for the reason the essence question transcend human knowledge.

From this point of view, we consider "abstract thing” and “real thing” production simply to be a process of sign production, and the organisation of these signs in knowledge bases simply a process of modelling. The final process of explication is simply the production of a "physical” model which is a necessity for successful human communication - in the sense that these models through this final step become shareable. From this viewpoint, the natural and social sciences will conflate and the objects of science are not merely the Machian sensation complexes (percepts), but rather all the (mental) phenomena of human thinking – percepts, fantasies, hallucinations, illusion and thoughts – in short the intents of thinking as advocated by Husserl during the development of phenomenology.

From this viewpoint, the original question: “What is science?” which was the reason for undertaking the investigation, is also the very object of science. This question, and similar ones, must also be fed into our scientific models. However, in asking such questions we proceed at a higher level – at a meta-level of inquiry. As is the case with all questions, these meta-questions will also produce a useful answer as an output. In that sense our traditional scientific models can be regarded as bare Turing machines programmed to provide an “output” from which useful answers can be extracted. Exactly in the same way, a thinking, rational mind must be regarded as a neurally programmed "biological machine" to produce an answer to the particular questions we ask. From this point of view, the tools of science are the theories/models used and the products of science are the subsequent answers produced by using these theories/models in a phase of application, i.e., [q(uestion) → model → a(nswer)]. We now understand that the type of an agent used for such computations is irrelevant.

So what is really being asked here is: Can science itself (or rather its theory/paradigm) be the subject matter of science? Once more we are involved in self-reference, in the same manner as previously, when asking what knowledge can say about knowledge. To ask what science can say about science is almost exactly the same question. Therefore this question is better reformulated into: Is there a science of sciences? The answer is yes, and we find the theory of different theories of sign production is such a meta-science. We can think of such a meta-science as a theory of theories of sign organisation and sign experimentation, i.e., the theories of modelling and computation/simulation. This is the very reason that a computer scientist is bound to be involved in the philosophies of science and this is why we think computer science can provide contributions of value to both scientific thinking and philosophy. However, in doing so, we will use the thinking and language of computer science, and this is why we involve meta-physics, meta-mathematics, meta-linguistics and so on, since all these activities can be very well compiled into the activity of meta-modelling.

The obvious parallels between science, communication, modelling and sign production are important issues seldom discussed and the meta-theoretical activity of these disciplines are rarely employed, but when doing so we must recognize:

In science we discuss the objects of science, but in meta-science the very object of dicussion is the process of science.

In modelling we discuss the objects of modelling, but in meta-modelling the very object of dicussion is the process of modelling.

When we claim, in this situation, that the objects of science and the objects of modelling are merely signs, then this is a statement of meta-scientific importance as well as a metaphysical one. However, for that reason we must not think of meta-science and meta-physics as being identical. Meta-physics is merely part of meta-science as is meta-modelling – and the latter is very much a theory of sign production. When we regard perception, imagination and modelling as a process of sign production – we begin to understand that the material essence of the sign has very little to do with its functionality in a knowledge domain.

This insight is facilitated by the recognition that that science is a human group activity carried out by some people engaged in the projects of knowledge production. In such activity the objects are the entities that we, on a personal level, are able to identify and “dress” into knowledge, and the very aim of the

57 That the realist’s juxtapose to the mental domain
activity is the **production of “well-dressed” knowledge that can be made into common property** – a knowledge base for use in human decisions – everyday and scientific.

Apart from the importunate essence-question of the objects of science, we immediately notice another difficult problem here, regarding the goals of science, as to whether science should serve the interest of the individual, some group, nation or the whole of mankind. Here we can, in Western science and culture, observe a gulf of a still more devastating kind than that of Cartesian dualism. This situation gives rise to a veritable gulf of trustworthiness that is inflicted on science. The crucial question here, both to man and science, seems to be under what conditions man has the ability to act “unselfishly” and instead act for the benefit of the group. Another question to address is the reason behind the choice of identifying with a specific group (our culture) in the struggle for survival and what mechanisms are involved in this process of identification. These processes all seem to reflect the classical struggle about man’s growth from childishness to the maturity of wisdom – that in a striking way parallels the growth of knowledge. We must recognize that even on this very sophisticated meta-level of human living this problem must be approached as a question about **knowledge acquisition, its organisation (modelling) and its subsequent application**. The claim advanced towards the end of this section is that such knowledge can be approached merely as signs and that scientific activity, from this point of view, are processes of sign production (observation), sign organisation (conceptualisation) and sign manipulation (experimentation). In doing so we find one huge advantage – that the essence-question will vanish.

On the other hand, we might ask if we are better off merely calling the objects of science signs. In one way this is a considerable improvement, since the “sign of car” seems far less conclusive and seducing that the notion of the “image of a car” or the “object of a car”, since the latter way of speaking has an obvious connotation to physical space. What we need for the re-orientation of our thinking is a better grasp on the sign conception and its relation to a model, which is the subject of the next sections.
1.4 WHAT DO WE MEAN BY "REAL"?

1.4.1 Introduction.
The word "real" is derived from the Latin word res that essentially means thing, event or fact. We find it in Descartes’ famous distinction res extensa and res cogitans where he by the term "thing of extension" and "thing of thought" suggested a distinction between the concrete and abstract sense of a thing. Such a distinction clearly makes reference to the human senses of touch and vision, but in a way that make it exceedingly vague. When consulting the dictionary we find a confusing number of terms that undoubtedly reflects man’s uncertainty in the use of this concept:

Real, although frequently used interchangeably with the terms that follow, pertains basically to that which is not imaginary but is existent and identifiable as a thing, state, or quality. Actual connotes that which is demonstrable. True implies belief in that which conforms to fact. Authentic implies acceptance of historical or attributable reliability rather than visible proof. Concrete implies the reality of actual things. Existent applies to concepts or objects existing either in time or space: existent tensions. Genuine presupposes evidence or belief that a thing or object is what it is claimed to be. Tangible stresses the mind’s acceptance of that which can be touched or seen. Veritable, which should be used sparingly, applies to persons and things having all the qualities claimed for them.

Actual is a temporary denotation, true is a logical, concrete and material are the engineering notions, existent the ontological, tangible the cognitive and genuine connotes to true. To this explication given by The American Heritage Dictionary we can add another row of synonyms: absolute, bodily, bona fide, certain, corporal, corporeal, de facto, embodied, essential, evident, existing, factual, firm, heartfelt, honest, incarnate, indubitable, intrinsic, irrefutable, it, legitimate, live, material, original, palpable, perceptible, physical, positive, present, right, rightful, sensible, sincere, solid, sound, stable, substantial, substantive, unaffected, undeniable, undoubted, unfeigned, valid that make us understand the project of finding a verbal definition is practically impossible. With this background it is of no surprise that the question of the essence and plausibility of realism has become so controversial that no account of it will satisfy all those with a stake in the debates between realists and non-realists. Such a multiplicity of interpretations and the lack of a clear definition, then also becomes the main cause that "real" has become the overstrained catchword of philosophy that it is.

Realism, the doctrine that genera and species are real things or entities existing independently of our conceptions, rose in opposition to nominalism. First, there is a claim about existence. Tables, rocks, the moon, and so on, all exist, as does the rest of the everyday world of macroscopic objects and their properties. According to realism the universal exists ante rem (Plato), or in re (Aristotle) in a domain distinct from human ideas that Descartes later specified by the use of res extensa and res cogitans. By the time of the scientific revolution res extensa was appointed as the only "real" objects of science and under the influence of the Newtonian paradigm the "totality of all real things" was called the "reality." "Realism" then becomes a philosophical doctrine stating that some of our perceptions derive from objects that can be scientifically classified as "real" contrary to the more "abstract" impressions of the human senses or mind. The human uncertainty as to what counts as "real" then contaminates the whole edifice of scientific realism. This uncertainty has in philosophy given rise to several subdisciplines, and the doctrines of realism are likewise divided. For this reason Niinilouto (p.1 1999), for instance, finds it appropriate to divide philosophy and thereby the problems of realism into six areas: ontology, semantics, epistemology, axiology, methodology, and ethics, which unfortunately causes even more confusion. Such an approach is very frustrating since the uncertain real/abstract distinction cannot be thus be avoided. A rather more fruitful method is to keep the discussions about the two principal epistemological approaches available, namely the object-oriented and the SOA and as a first step, keep the real/abstract distinction uncontaminated.

In 1958 Schrödinger drew attention to the two general principles that “form the basis of the scientific method, the principle of the understandability of Nature, and the principle of objectivation” that summarizes the two basic ideas underlying the Newtonian paradigm. Let us rephrase the first principle into “Nature can be understood” and then we, through the use of the words "Nature" and "understood", realise that what is here referred to as "understood" is not Nature as such, but rather the knowledge of Nature. This simply means it is possible to find some basic ideas (axioms) that can support (stand under) science’s knowledge edifice of Nature. This statement expresses the human belief that firstly human knowledge is possible, and secondly that Nature can be the subject of such knowledge.
The mental impressions of each living being bear the evidence (proves) that my knowledge is possible, however not on a private basis. Because of the primacy of subjectivity such evidence cannot be “objectivised”, which violates the second principle. We also believe mankind as a group can compile scientific knowledge and the realists firmly believe the basis for such knowledge is observation. Furthermore in the statement “Nature can be understood” the term Nature is taken as an axiom for the process of knowledge acquisition that accordingly must be "pre-given" to the same process. The "pre-given-ness" of Nature is also a firm belief of mankind and notwithstanding all knowledge is intentional, i.e., is in need of an object.

This situation gives rise to the well known "container analogy", which is the assumption that knowledge is "contained" in the object of knowledge. In this view it seems quite natural to assume that this "contained knowledge" is independent of the eventual receiver, i.e., non-subjective or objective knowledge. Furthermore this view takes for granted that the very definition of an object is unproblematic but we will see that this is not at all the case, since objects are bounded regions in space and time. However, there is an even more difficult problem to face since Nature and the knowledge of Nature on the realist’s view are separated both in space and time.

According to the classical view, Nature transforms into "knowledge of Nature" in the knowing subject by way of observation, which is a process with a specified causal direction where Nature is the cause of this knowledge. Scientific knowledge is derived from Nature by observation and this has become the basic trait of scientific description and experimentation. Science starts with observation, which should mean that a mental impression emerges in a living individual. However in this process the realist without further ado assumes that Nature is the cause of this impression and this is possibly misleading and from the individual’s point of view there is no means to undertake such a decision. Furthermore the realist assumes that observation supplies the secure basis upon which scientific knowledge can be built. He in a sense assumes the "pre-given" Nature also gives rise to "pre-given" knowledge. Furthermore science has, by the comparison of individual knowledge, found that its knowledge for different reasons is "blurred" and therefore scientific knowledge is on a regular basis derived from observation by induction – this encourages the use of statistical methods of observation. Science, at least in its classical vein, tries to keep up the idea of certainty by the assumption that the statistical methods can yield a quasi-certain "mean value." Accordingly the main tenets of the Newtonian paradigm, which are more or less the naïve man’s view, can be summarised as follows:

- Nature is pre-given
- Nature transforms to human knowledge by observation
- Such knowledge is the certain base of scientific description and prediction

The realist’s doctrine further adds that Nature is "real" contrary to the knowledge of it, which then is "abstract" reinforcing the dualistic attitude of the Newtonian paradigm. We find that the dualistic view separating what is "real" from "imagination" that emerged at the dawn of science (see section 1.2.1) has survived, firstly in the form of a scholastic doctrine of realism opposing nominalism. This claimed that universals exist independently of their being thought, which later, under the influence of classical physics, turned into the modern philosophical doctrine stating that physical objects exist independently of their being perceived.

We note that human observation is central to this paradigm, which in turn is heavily dependent on the faculty of vision. At the beginning of the 20th century human vision seemed effortless and obvious to science. The idea was that we simply open up our eyes and observe the surrounding world. With a passing glance we perceive the shapes of complex objects – so were the thoughts - and this we can do whether those percepts are familiar to our knowledge or not. However this apparent ease and directness was highly deceptive, and we will soon understand it has in fact kept the mainstream of science on an uncertain track for some thousand years.

Briefly the question is: What do we perceive and how does it transform into knowledge? We simply ask for the essence of the worldly things and in which way this essence is transformed into human knowledge. Looking for a better answer traditional science has rejected the naïve realist’s answer: We perceive things as they are. But what if there is no such answer to the essence question then we have to be content with the naïve man’s proposal: Things are as they are and the world is as it is! What on earth did we expect as an answer? Things are feelings, we have learnt that we perceive primarily not things but events -
and we have found out that an event is also a rather complicated concept. We have learnt the homogeneous and eventless universe of Parmenides is unobservable, as conscious experience primarily is change - nothing more and nothing less. However we do not experience all events - only a very tiny fraction - just those that affect us and are important to us: the light bouncing off the surface of the lake and hitting the retina of our open eye. The cry of the gull flying nearby and generating sound waves that set our ear drums in motion, the flame licking our hand, the ravishing taste of a good Burgundy etc. Whatever we perceive is all sequences of events, and not just any, but events defined primarily by our own human possibilities. Our perceptions are in turn event chains in conscious experience, which sometimes are thought to take place in some neural substrate of the plastic parts of our own sensory cortex. They are not thought of as autonomous events, since we believe they are built on the "clues from outside", and as such they are events that define a "private reality", which we prefer to attribute to the surrounding environment or other parts of the body – most often in the form of the objects of human knowledge. We must further investigate the correctness of this "container analogy" that most of all seems to depend on the naïve man’s belief.

However these events taking place in the plastic parts of our own sensory cortex cannot be examined or observed directly – this is the utmost meaning of the primacy of subjectivity. However we can as scientists observe our own impressions by noting the feelings associated with each impression - the content of each impression. When we want to discuss this neural substrate (which is the term for outside scientific use) and its content we can very well discuss the mental impression and its content (which is the inside term) and we must pursue this discussion in terms of models belonging to a modelling framework. These items can be explicated for communication only as models – and most often as a set of models. The spoken language supported by some other conceptual model is a common example.

It might be that science in the future is able to find a neural substrate, which is the source of conscious experience, however such a finding will have no bearing on the "content" of conscious experience. For a science, in addition to the ambition to understand what consciousness is, has to understand the cause of it, what its functions are, and how it relates to non-conscious processing of the brain. Conscious experience, i.e., the mental impression of mind is obtrusively "real" to any human being, and this is indeed the very reason why we are looking for the neural substrate of consciousness. As our scientific understanding deepens, our understanding of what consciousness is will also deepen, but we will perhaps never find or be able to grasp the neural substrate of consciousness. All we know and can know is its sign - the complex impression of feelings. The essence behind this complex feeling will remain hidden to human knowledge in the same way, as is the essence of the "thing-in-itself." However a useful science does not need to know the essence lying behind it – and we will later show beyond human doubt that we cannot even know it. In spite of that, it is possible for science to continue as before, since science has always been and is most of all a play with signs – which should be called models rather than "real." For this reason modelling emerges as the central endeavour of science outdoing observation.

1.4.2 The art of modelling.

Central to the classical scientific methodology is observation and subsequent modelling of the phenomena observed – the latter is the obvious means of description and inter-subjective communication. Figure 1 portrays a meta-model of this very activity, displaying its two distinct steps of observation and modelling. These two activities define the perceptual and the presentational paths respectively and this meta-model is a useful tool both in the object-oriented as well as the SOA. These two approaches are reviewed in detail in several of the Collected Papers. The deciding difference here is that the SOA questions the status of "real" attributed to the worldly things as advocated by scientific realism and in the same vein also the usefulness of the "detached" observer approach as prescribed by the Newtonian paradigm. As a matter of fact one more important further step is taken by the claim that the realist’s doctrine and its supporting Newtonian paradigm is the very reason for the present state of crisis in modern science.

Both in the classical view and the SOA modelling (or presentation) is the means to explicate what is in the mind of the thinker/observer. The OOA very often takes on board the confusing view that the scientific observer, without further ado, is the "objective" observer, a claim that sounds very strange to the defenders
of the SOA who in fact claim such observations are impossible. The classical approach also, through habit, assumes a sender/receiver view of perception and we rather advocate an action/reaction model. The SOA, in fact, claims that perception is essentially a neural modelling process, and through this view the process of observation/presentation becomes a two-step serial process of modelling.

In the previous section 1.3 we concluded that science is a group activity concerned with the acquisition and organisation of knowledge and its subsequent application, i.e., finding a solution to the problem originally posed. We there mainly focused on the question of intentionality, i.e., what are the objects of science and suggested that these are the phenomena of mind, which in the form of percepts and imaginations are the objects in a process of cogitation (imaginative thinking). We there concentrated on the first perceptual step of meta-modelling, and played down the question about the essence of its objects, in short we dismissed the ontological “essence-question” as undecidable (Figure 2). The undecidability of the essence-question clearly jeopardizes one of the solid cornerstones of classical science, namely the idea of a "pre-given reality." For that reason we must discuss the possibility of assuming that the mental phenomena of the human mind are the primary ones and make up the actual UoD of modern science. We further bracketed the question of “what knowledge (or science) can say about knowledge” (i.e., the question of what is the essence of knowledge), because of its self-referential character. From this viewpoint a mental phenomenon must be regarded merely as a sign, i.e., distinctive mark, characteristic, or feeling (sense effect) indicating identity more or less in the same manner as a written signature. In the coming section we will investigate the signification of the sign conception.

Furthermore we concluded that a model is a means of knowledge (re)presentation and that such a model is foremost personal and private. We settled the primacy of subjectivity, and in doing so we noted that modelling is the only available means of knowledge presentation for inter-personal use, since we cannot even get hold of the mental impression of others without the use of signs and models. Even more importantly, it must be concluded that in a situation where I lack access to my own mental impressions (figure 3) I should not even be able to grasp my own knowledge. Needless to say such a situation would be disastrous since sense impressions and feelings are the only means available for the surveillance of my body and environment that are needed to guide the actions of life. The understanding of this mental impression (mental model) and its supporting “projection mechanism” is very central to the SOA and in due time we will grasp the full significance of the transcendental character of this process. Therefore the enterprise of modelling is central to the activities in which we “understand the world around us” – the crucial question is, however, the way in which we interpret the term the "world around us." Do we here refer to one singular “universe” as the realists claim or does each living being here have at his/her disposal a private universe – a priverse?

Scientific modelling, information systems modelling and the everyday modelling of the commonplace person are very similar in principle. A man’s model of the presumed surrounding world depends on the knowledge and reasoning strategies that during a lifetime of action and experience are encoded in the neural networks of his brain. This experience directs the way he perceives and classifies his environment and chooses to react to the happenings occurring there. For a living being the enterprise of model building is the only means to ward off social isolation - and mankind has used this effective means to build such a strong social network that it has come to totally dominate life on earth. Human knowledge is the prime stuff that models are built from, and the art of model building explores alternative ways to (re)present this knowledge. At a later stage intellectual analysis and simulation are used to explore the behaviour of the different models developed. Disciplines such as general system theory, mathematics, physics, computer science, philosophy, psychology, linguistics, and cybernetics focus on different aspects of modelling, which all offer a selection of interesting.

58 In the traditional view a model is a representation of a thing of reality (a copy), but in the subject-oriented approach a model is the primary conceptual appearance of a hypothetical “outside” phenomenon and should for that reason be called a presentation – for this reason I sometimes use the dual (re)presentation notion.

As a matter of fact each research discipline has its own favourite set of modelling frameworks, that are used on a regular basis, for description of the phenomena encountered in this discipline. As such they are very often regarded as being part of the disciplinary paradigm. Furthermore we note that modelling has become a very central, if not to say dominating, endeavour in several disciplines e.g. in computer science, systems science, information technology, enterprise modelling architecture, land surveying and simulation analysis.

In “The Art of Modeling Dynamic Systems” F. Morrison (1991) starts off by saying:

Modeling is neither science nor mathematics; it is the craft that builds bridges between the two. Statistics is already well established in that role. Dynamics is much older than statistics, but its development and range of application lay dormant for the first half of the twentieth century, waiting for the technology required to construct automatic computers. The Art of Modeling consists of matching the behavior of computational processes to that exhibited by series of measurements. Geometry and other abstractions must be reduced to a constructible series of numbers. Reality, such as it is, must be reduced to another series of numbers, which now may be compared with those computed from a candidate theory. After theory encounters fact, the modelers may revise their equations and computer programs and the observers, their instruments and procedures. (Morrison, F. 1991 p.1)

This is a very mathematical view since in his world all phenomena reduce to numbers. However life is not simply number crunching - life is something much more colourful. However, inspired by the Newtonian paradigm that cut both ways, mathematics has abstracted from the “aspects of content” of the phenomena of life, i.e., from the human feelings.

Modelling is a central enterprise in both science and art, and both are recognized as group activities. Since scientific modelling, furthermore, is driven by a paradigm it then fully complies with the requirements to be called “a science” (Kuhn, 1962). Nevertheless modelling is seldom regarded a “science on its own” for the simple reason that it is part of and a necessity of all scientific activity. However, this is also true for many social activities that we are not prepared to classify as sciences, no matter if we are talking about fine arts, music or monkey calls - modelling is primary and the only means of inter-subjective communication. So the idea of making a distinction between scientific and non-scientific modelling on the grounds of an underlying paradigm seems in vain. Inter-subjective communication is only made possible by means of modelling and is, as such, a group activity in need of a paradigm (set of shared activity rules). It seems to be the principal way in which we specify these rules of paradigm that can encourage the use of the term scientific and for this reason we should refer to modelling simply as the art of modelling.

1.4.3  System identification - finding the source of modelling.

In section 1.3.11 we proposed that science is:

a) The collection and organisation of human knowledge into models
b) Its subsequent “computational” application in structures of [question → model → answer]

We thus find that science is an activity of modelling and subsequent computation (figure 4), activities that are pursued both at a private and an inter-private (group common) level. At both levels this activity is driven by a paradigm, i.e., is supported by a set of rules specifying how this activity is to be performed. Furthermore it seems these activities are classified into art or science depending on the quality and accessibility of these rules of paradigm, but regardless of such classification the process of modelling and its final product – the model - are very central to this endeavour.

Given this background we find that the central issue discussed in this thesis, as to whether the objects of science are "real" or not, more or less coincides with the
question as to whether the objects of modelling are "real" or not. The answer to this two-fold question, if there is any, will also provide us with the answer as to whether scientific realism or anti-realism is a useful attitude when approaching the problem of human knowledge acquisition. Accordingly, from the proposed view, the objects of modelling and science coincide and since we have already repeatedly claimed that the question of the "essence of these objects" is circumstantial, this situation will make the system identification phase of modelling stand out in a brand new light.

In the traditional realist approach system identification is a very difficult task and is therefore unfortunately often tacitly passed over, which, unless the UoD is very familiar, inevitably results in conceptual confusion\(^59\). System identification aims at establishing the relationships between the observer and the "system under investigation" or the "area of interest", and the latter is most often regarded as a "pre-given" thing or part of "reality." Such systems are most often defined through a collection of entities (objects), their relationship and behaviour relevant to a set of purposes. We might call this an entity-oriented approach, and the entity in question is regarded as "abstract" or "real" depending on the definition of the "area of interest." When the "area of interest" is regarded a "part of reality" then the object of observation is taken as a given as "induced" by the observer's perception of this reality. This situation gives us a reason to name this approach the object-oriented approach, because the entities appearing in the observer's percepts are thought determined by the "pre-given" objects of "Nature." From this point of view these objects are reduced, very much guided by personal preference and the purpose of the investigation, to schemata making up the concept models that describe this relevant part of reality. E.g., when studying the causes of war, a nation could be a relevant entity, the bouncing of a ball can make the ball a suitable entity, as well as quanta are when studying interatomic processes. The entity model can, from the realistic viewpoint be thought of as a "projection" or an "image" impinging from a given outside world by means of a stable process of mapping in its mathematical sense.

From this dualistic viewpoint, system identification generally means a definition of the "real" system of interest, its domain and its relevant parts (objects) and their interaction including the systems interaction with the environment. These complex domains are then reconstructed by processes of abstraction\(^60\) that are attempts to reduce the complexity of the problem met with, and we understand that the purpose of modelling in this case, has a deciding influence on this crucial phase of the system identification. The model entities resulting from such abstractions are generally seen as reduced representatives of the pre-given objects of reality. From this viewpoint, system observation is thus a purpose-driven activity and there is never a best or even a "correct" model. The usefulness of the models always depends on the objectives and context of application and is in this way dependent on the view the system observer prefers to use, which is generally inspired by the disciplinary paradigm. System specification and system identification and subsequent modelling in its classical sense is a highly iterative process, where the developed models are subject to comparison and further refinements in the light of the "pre-given" reality.

In modelling an abstract domain, the phase of system identification and specification gives rise to quite a different problem. Here the system is, with its fundamental entities, often given only by the imagination, and the problem here is to formulate these ideas into a set of models for consensual use in a way that can promote a common understanding. The entity model (as part of the mental phenomenon) is not the result of a mapping process but rather the result of a private process of imaginative construction. This is the systemic approach that is part of systems thinking which is usually referred to in philosophy as phenomenalism or phenomenology, depending on the significance one is willing to attribute to sense data.

Since the human brain is responsible for this private process of construction, the path to consensual understanding of such models is through learning and close co-operation. The minds of people intending to participate in such projects have to be "tuned", so to speak, to a state of consensual understanding. This is also the way a scholar is trained to become a worthy member of his scientific discipline:

\[^59\] See collected paper No 2, "Networking is another facet...."

\[^60\] See collected paper No 1 "An Intuitive Approach to Modelling and Simulation"
This sounds like a gentle variant of brainwashing, and as a matter of fact it is, since such a process simply is a means to "tune" a human brain to a specific way of understanding. This is done, hopefully, for the benefit of mankind’s effective cooperation and not for some selfish reason. Since science is a group activity the certain state aimed for is a state of consensual understanding that will reduce differences in opinion and choice of words. In accordance with modern cognitive sciences, this thesis also claims that the human brain is involved in a tuning process at a deep level that influences the way we perceive the presumed world. However this is not the place to linger on this subject but we must note here that accordingly your and my brain are also "tuned to Newtonian thinking" in this way by a life-long process of training. This situation is also the major reason for the difficulty in grasping the SOA.

From the realists viewpoint, the modelling of real systems seems entirely different to that of modelling abstract systems and when it comes to system identification since, in the first case, we can rely on pre-given things of reality that are fairly well understood by all human beings. If the realist is correct in his/her claim that the objects of science (and modelling) in that sense are "pre-given" and human perception at the same time is independent of the individual observer (doing the observation) it thus also follows that the entities contained in perceptual impressions are also "pre-given" to human contemplation. In this situation system identification is more or less a problem of carrying through a series of "correct" observations, and the unbiased observer will, in this situation, define "correctness." Such an ideal observer is in possession of a perceptual apparatus that is more or less transparent to the incident input stimuli. We recognise the unbiased observer as the ideal scientific observer – the objective observer.

In the case where the system is not pre-given by perception, but rather specified by imagination – as is most often the case in abstract systems sciences - the modelling efforts cannot fall back on human perception but must rely on verbal specifications and/or analogies. However also in this case - and this is important to understand - it is still possible to use entities and concepts that are familiar to us by perception. In this case, however, we must recognise these entities are just models (analogical models) and certainly not basic pre-given entities of the system under consideration. We become acquainted, for instance, with the properties and the behaviour of stone entities by throwing and watching them. At a later stage in life we are then taught in physics that electrons behave like stones and through this method of analogical thinking we are presented a "short-cut" to the understanding of the "electron" behaviour. By analogy we are accordingly given "model behaviour" of the electron so that its behaviour can, in certain situations, be modelled by the "stone" behaviour. However this does not license us to think of electrons as stones – or that they are similar in every respect. The point-mass of an atom e.g., is a concept given to us by perception that says very little about the "real" atom besides attributing a momentary location for it. In this case when considering the atom, we can take neither the system nor the entities of the system as pre-given and human contemplation are bound to take off from the specification of the imagination, for the simple reason this imagination is all there is. The conceptual schemata (i.e., the realist’s reduced representative) that science makes use of are mostly entities of human imagination that appear as compressed verbal specifications, i.e., schemata coded by measurement. The realist objection to this situation is that this state of affairs is in force only for abstract objects, i.e., entities of human imagination. The "real" entities in science can be approached quite differently so the realist claims; otherwise there would not be any realist-antirealist dispute.

In spite of the realists insistence, the above line of thought hints to us that a great deal of human knowledge is based on entities that are given to us by imagination rather than by some direct perceptual evidence presented to us by pre-given objects. We are once again reminded of the play on the stage of the puppet theatre and we rightfully ask: Maybe the essence and appearance of the "place holding" puppets are irrelevant in the play of life? Maybe science has no relevant use for the real/abstract distinction or could it even be that this very distinction is the root of the present state of confusion?

When we turn to the abstract sciences and the SOA we cannot, as before, specify what conceptual framework to use when constructing a mental entity model (also called concept model). Here the basic entity is not given once and for all, and neither is there any advice as to how to reduce the complexity of the impression of perception. In that sense “anything [that is useful] goes” as Feyerabend (1970) once remarked. In this situation the commonsense view of reality - which is partly biologically programmed into our brains and partly learnt by experience - is not necessarily the best one to use in a particular scientific endeavour. In
this situation we must furthermore admit that everyday human observation is also driven\textsuperscript{61} by paradigm - even if tacitly. Once recognised this situation will open up the possibility to new approaches for the construction of scientific concept models. We must recognize that the OOA and its commonsense view is a dictum spelled out in the 17\textsuperscript{th} century – and is thus apt to modifications for that very reason. Even more important is the recognition that the OOA and the supporting Newtonian paradigm also, for other reasons, needs substantial modifications\textsuperscript{62}, since it is neither complete nor consistent in its present state.

Taking on the subject-oriented view there is, contrary to the classical view, only one source of modelling (Figure 2) and two models – firstly, the outward projected image (the mental impression) that emerges provoked by the "clues from outside", and secondly, the physical model that is produced for the sake of human communication. Here we deal with two models belonging to \textit{different domains of affiliation}. The mental impression that is "seen" as outwardly projected onto the apparent "car" – the allusion - and physical\textsuperscript{63} model intended for presentation at the right hand side of the figure. In one sense the mental "model" is the true private model since this is the brain’s output (the impression) of an irresolvable combination of the incident stimuli (the clues from outside) and the conceptual theories we embrace in the situation met with - \textit{sort of a theory-laden biological model}. In another sense this "model" is not a model at all – \textit{since this is the ‘very original’ a human observer has at his/her disposal} – and notwithstanding the only one. Since we in the last section concluded the essence of the phenomena studied has very little significance, \textit{these mental phenomena can be considered as bare signs participating in a scientific "stage play" – a conceptual simulation}. As a matter of fact they are since we in the coming will show that nobody can answer the question \textit{what there is else to an abstract (mental) phenomenon but complex of signs}. \textit{This is part of Peircean metaphysics [Pierce (1931-58)], specifying that statements as to the ontological essence of phenomena has no place in the abstract domain of knowledge} – and neither they have in the SOA.

In that view all human mental impressions can be successfully \textit{regarded as signs}, and the recognition that cognition and thought are barely signs was the point of departure in Peirce’s theory of sign. Signs are to him not a class of objects, as they exist only in the mind of the interpreter: "Nothing is a sign unless it is interpreted as a sign" (ibid. § 2.308). Peirce went even further and concluded, "the fact that every thought is a sign, taken in conjunction with the fact that life is a train of thought, proves that man is a sign" (ibid. § 5.314). Pondering the very essence of these ideas, we find, taking the stance of methodological solipsism that the following conclusion is inevitable: \textit{I and all my thoughts are (mental) signs, i.e., a mental sign domain in its totality}. So using the semiotic approach, i.e., regarding the mental phenomena of human perception and imagination as signs, we are able to specify the important questions\textsuperscript{64} of human perception accordingly:

\begin{itemize}
\item[d)] Is there a basic sign entity (axiom) and how does it relate to a pre-given Nature
\item[e)] In what way are we able to describe (explicate) such signs
\item[f)] How do we join together such signs and their explicates to provide modelling structures
\item[g)] What is the expressive power of such a modelling framework
\end{itemize}

From that viewpoint, the locus of impressions in our minds – human awareness - is the centre of signification - and the tokens appearing there are mental phenomena – indicating (pointing at) some outside or inside hypothetical entities, at a place totally apart from the locus of the mental phenomenon: To the extent we can learn to build experience about such mental entities we can learn to know - and further - to the extent we can learn to \textit{exchange this experience} with fellow beings, we can build cultures and sciences. We conclude that these mental impressions (feelings) are the indication of both an "outside" and "inside" and constitute the tokens of life that we learn to manipulate by a process of thinking. Perception and our thinking provokes such impressions of signs and in that sense they are the results of \textit{mental acts}, and we will in the end understand these are acts of allusions.

To break our inborn social isolation, however, these mental tokens must be \textit{explicated}, in order to be accessible to (perceivable by) other beings, in short they must be \textit{modelled and laid out in a form we call

\textsuperscript{61} See Kuhn, (1962) “The Structure of Scientific Revolutions” p.113.
\textsuperscript{62} See Collected paper No 5, “The Subject Oriented Approach to Science and the Role of Consciousness”
\textsuperscript{63} This term should rather read the “model of physical affiliation”
\textsuperscript{64} In phrasing the questions we, for the ease of explication, use the words “mental” and “physical” in an inconsistent way, because in the subject-oriented approach there is only a mental domain
physical. This calls for special acts that we call acts of physical token production. Here the basic element is also the sign, but in this case we aim at the production of permanent (stable) signs. Such signs are called symbols or using Eco’s semiotic terminology - sign vehicles.

Adopting this view we can say that a mind sign – the mental impression – is created in a mental act of sign production, whereas the physical sign – the symbol - is created in a physical act of sign production. In this way we discover that both human beings and science interact with their environment with a common and characteristic action-reaction pattern called experimentation:

\[ \text{action} \rightarrow \text{"world"} \rightarrow \text{observation} \] (of reaction)

i.e., we act upon the world and find out how it reacts by observation and at the "inner" mental level we find:

\[ \text{mental action} \rightarrow \text{mind} \rightarrow \text{mental observation} \] (of feeling reaction)

However in the subject-oriented view the "world" is nothing other than the organised collective of mental impressions (signs) – the priverse – which in a sense is nothing else but my mind, an idea that immediately connects to Pierce’s idea that “that man is a sign.” This is the SOA at its extreme, since we all through subjective experience perceive all other living beings simply as signs. The situation that we all provide these signs with "content" is simply the result of human experience that is also the sound basis for prediction and without which such acts of prejudicial mental simulation is simply impossible.

This action-reaction pattern of simulation is very common in control theory, where the object under investigation on a general basis is treated as a "black box", i.e., the inside components are regarded as unknown in contrast to the "outside" behaviour. Control theory has clearly shown that we do not need "essential" knowledge about the inside of the "black box" for the purpose of controlling its behaviour. Applying some action to the "black box", we can, simply by watching the "output", learn the necessary "input" to control its behaviour provided the "black box" is fairly stable.

However watching the "output" is plainly perception, and the human acts we inflict onto the entities of the world are simply the "inputs" to the private "black-box world"- this is the way human action and perception works. From that point of view the quest for the pre-given components of the "black-box" is in vain, because there is no answer to find, as we will soon find out. Constructing models are, for the sake of communication on the other hand worthwhile, even if there are infinitely many models possible to find. Some models are better, but what is "better" or "worse" depends on the goals stipulated. When we change the goal we might find we have a "poor" model – and then we have to change the model. We will find there is no one "correct" model, and there is no God’s Eye view.

The central point here is that the phenomenon acted upon, both in the case of mental and physical action, is in the world of mental impressions (the priverse), because even a physical reaction can only be seen by means of perception. In this respect human perception does not differ from imagination and cannot be successfully separated – something Quine (1951) clearly pointed out. This is the most important conclusion we can draw from the discovery that human perception is theory-laden.

So apart from direct physical action, from violence to tiny manipulations, which of course is a most important means to influence its life and environment, acts of token production are also a useful means to influence its environment on the social plane. Such acts of token production are the main tenets of the following activities:

1. Explication/explanation
2. Self-communication
3. Inter-communication

A closer look reveals that these three activities are actually only one: Modelling as the available means of communication – and as such the only means to circumvent the restricting primacy of subjectivity and pave the way for a useful social cooperation. Communication is what humans are good at – not the exploration of essence.
We find that system identification is a problem of defining a set of useful entities meshed in a web of connective interaction that can explain the system and its behaviour and furthermore why the system in question is regarded as separated from its environment. When we take this structure as a given, as in the case of human perception, we assume the basic tenets of scientific realism – the system’s structure is given to the knower by observation, i.e., the pre-given object transforms into human knowledge of something called the Nature. The world is revealed to mankind simply by discovery.

The systems sciences, on the other hand, have shown that scientific realism cannot provide a useful paradigm for the exploration of the abstract realms of human imagination. In this case very little seems to be pre-given – apart from the spoken language and the blinkers of human perceptual habits. However there are reasons to believe that human knowledge build-up can take off – in bootstrap fashion - from some primary experience that is further developed in steps through construction. Regarding this view we are free to invent entities and structures that simplify the coming "computational" application in structures of [question → model → answer] and further human communication. Such structures are models for human conceptualisation where the eventual Nature is unable to provide a truth template. From this point of view the realist’s doctrine is untenable since the colourful things of the world here reduce to mere signs of presumed "real" things of a transcendental domain. These "real" things are absent to human conceptualisation but are connected to human knowledge by means of signs – or rather sign-functions. The next step is to establish such a connection.

1.4.4 The sign-ature of absent things.

This thesis claims, in accordance with Kant, that the quest for the “essence of thing” is undecidable, and when one accepts this thesis the worldly thing immediately reduces to an “empty shell” - a conceptual boundary lacking of ontological content. In that view a thing is merely a sign (name-badge) and this insight connects us to Peirce’s metaphysics. He considered that a sign, like a thought, refers to other items and to the individual’s knowledge of the “things” of the world so that “all what is reflected upon has [a] past” (§ 5.253 in Peirce (1931-58)). Peirce even went one step further to conclude that, "the fact that every thought is a sign, taken in conjunction with the fact that life is a train of thought, proves that man is a sign" (Pierce, 1931-58, § 5.314). Taking this route when approaching human knowledge acquisition, one finds the following conclusion inevitable: all my thoughts and I are (mental) signs, i.e., human knowledge is a domain of mental signs in its totality. Taking the Peircian stance that the valid objects of science are signs will prove to be a very fruitful approach – which fully confirms the ideas of the SOA, because from the observing subject’s point of view it matters very little if the “dance on the stage of the physical environment of mine” is regarded as being performed by signs or ”actual things.” As a matter of fact both the SOA and Peirce maintain that signs are the "actual furniture of the mental world" – and that a web of signs is all there is to human knowledge. However in this interpretation we consider a sign to be a purely mental phenomenon, which in a sense is very close to the abstract phenomenon the realist, produces in the unspecified "process of abstraction.” This situation will be evident in the next section when we turn to the “science of signs”, i.e., semiotics, the status of which e.g. is summarized by Eco (1979) and Noeth (1995), but first we introduce the sign concept through an analogy.

To elucidate the situation, we firstly draw up a very illustrating parallel between a stage actor and a semiotic sign. As a matter of course, an actor privately "stands for him/herself.” However as a professional he/she, on the stage, stands for (indicates, signifies, symbolizes) somebody (or something) else. In the ongoing drama the very figure of the actor is intended to indicate "something else" but the actor him/herself.

How come some phenomena need a sign (substitute) to "stand for them”? It is well known that a stage actor in general stands for "somebody else" because the intended person for some reason is absent. Like Hamlet, e.g., he is absent – he might e.g., be dead, far away, unwilling to participate, invented etcetera and to make up for the original’s absence the actor takes on the role as "placeholder.” To follow the play we must, in every situation where the actor appears, envision him/her substituted by the original Hamlet.
(interpretation) and the actor’s figure is thus a trigger of the spectator’s interpretation. The common denominator here is that the actor (sign) stands for something that is absent in the play and the actor (sign) has the role as a "placeholder" thereby indicating (symbolizing) the original actor or object. However it is most important to notice that the observing spectator has provided this interpretation on his/her own, i.e., the observer’s knowledge is a necessary part of the successful interpretation. Hence we are able to establish such interpretations by the assumed two-fold function of the sign’s functionality, namely: a) the "actor’s figure" (appearance), which is a pointer to a place in a table and b) the observer’s knowledge that will furnish the final step of the interpretation. When we in this situation change either the actor’s figure or the observer’s knowledge a new interpretation will emerge.

As realist student I was firmly taught to believe that human mental impression in this way was a sort of "miniature image" of a (mentally absent) but pre-given "worldly thing" – in short a mental product of a "process of abstraction" that in one way or another produced a "reduced image" of the pre-given thing. Such a mental entity was given a "symbolic name" that participated in mental activity. This view of human mental activity as manipulation of a physical symbol system was highly fuelled by Newell & Simon’s 1975 ACM Turing Award Lecture (Newell & Simon, 1976) and gave rise to the branch of artificial intelligence as advocated mainly by computer scientists. As realists, we can comprise this use of physical symbolic signs better in the context of scientific prediction and explanation. Here we normally use experiments to produce answers to different scientific questions, and in physical experiments we use the "full scale exemplars" of phenomena conceived for that end, i.e., the phenomenon itself and the answer to the question we acquire by observing the resulting situation. However in many situations we simply cannot do such experiments with the "real" phenomenon in question and are then instead directed to use a representative and in simulation analysis, as in mathematics, we therefore produce signs (or symbols) to represent the "real" phenomenon, exactly in the same way that the director has instructed the actor to represent Hamlet in the drama. These signs are then manipulated (computed) according to some set of specified rules and are finally interpreted "back to reality" so as to provide the answers to the question posed. We must carefully note here that in traditional science, human thinking is envisioned as the mental manipulation of symbols, i.e., as the manipulation of real world representatives (representationalism).

The symbolic sign here acts as a "placeholder" in a play that tries to mimic the "happenings of the world" in a way that fully parallels the actor’s performance on the stage. However the "actual shape" of the sign (or actor) has little significance, i.e., the actor need not look at all like Hamlet. We only note that the "shape" must remain stable during the play. What is important, however, is to note the act of interpretation that is necessary to fully and finally establish the sign-function. Here the symbol/actor is the sign, but the spectator is the one to provide the interpretation that connects the sign/actor to "something else" and notably this connection is very often made by reference to the knowledge and/or social conventions embraced by the spectator. For instance signs such as "John", "mother" and "dog" refer to phenomena that are familiar to human experience that we, through our upbringing, education and co-existence have learnt to connect to certain perceptual memories. In this way we are able to model situations like “dogs are four-legged creatures” in the absence of an actual dog-impression. In this way signs and word-symbols in language, icons in aesthetics, constants and variables in mathematics and actors in a stage play "stand for something else" by means of knowledge and the habits of social convention.

This technique of explaining e.g., some new phenomenon in terms of "something else" does not only apply to signs but also to sign structures (models) and their behaviour. In that sense, to understand a phenomenon, is more or less the same as being able to connect it to some bulk of experience that is part of our social habits. For instance, when we want to explain to somebody how electricity works we often make use of an analogy that connects the phenomenon to another familiar everyday phenomenon, because then most human beings have a reference library of their own that can provide the necessary understanding of the behaviour of the as-sign-ed phenomenon. That is by providing a social convention e.g., that connects a "particle of electricity" (electron) to a particle of water we create an electricity-water analogy that is very helpful in explaining the behaviour of electricity in terms of the familiar behaviour of water. Also by connecting the "electron" to one of the orbiting planets of the solar system we try to explain the behaviour of the atom in everyday terms and are the only way to create an understanding. We can literally say that the interpreter needs an understanding of a fund of experience to understand (support) the new phenomenon. We can say that everyday analogies are the useful tools of understanding because then every human being has a private fund of experience to refer to.
So a sign "stands for something else", as do symbols, words, icons, statements, models and even theories and paradigms. Here we find a hierarchy of indicators that are all used to indicate "some other phenomenon" and the idea is that the "actual phenomenon" is thought to be absent in the thinking mind. When such phenomena are interconnected into structures of tokens we call them systems. However the crucial question is what a thinking mind, supported by human knowledge, can say about the conceived "actual phenomenon" – in particular we will ask if some phenomena can be considered more "real" than others. This is the issue we will address in the coming section.

1.4.5 Token, sign-function and signification.

Before we scrutinize the processes of perception and modelling we must further investigate the sign conception and the process of signification, because human mental impression will be considered further on as being signs – or more correctly tokens belonging to sign-functions. This is the province of semiotics, and F. Saussure (1916) who is considered to be the founder of structural linguistics gave the basis for the opinion that a language is also to be seen as a system of signs. As an extension of this idea he put forward a proposal about a general theory of sign functions called semiology, which he likened to social psychology. Those who see semiotics as a theory of communication basically rely on Saussure’s linguistics and this domain is the primary interest of many sciences. We will in this thesis, in parallel with Lothman (1967), adopt the idea that a language is a framework for modelling and also a model is to be seen as a system of tokens or signs. In the wider perspective of modelling, however, we need a better grasp of the process of sign production, which is the sphere of interest of semiotics, and for this reason we will connect to this theory as espoused by U. Eco (1979). In this work semiotics explores the “theoretical possiblility and the social function of a unified approach to every phenomenon of signification and/or communication and as such a design for a general semiotics,” (Eco, 1979, p.3) which considers a design for general semiotics as:

A theory of codes
A theory of sign production

This theory takes into account a large range of phenomena such as the common use of languages, the evolution of codes, communication, the use of signs to present states of minds and states of the world, etc. In a modelling context we are in need of signs to signify the mental impressions of the human observer and when discussing the realist’s approach we also need some means to denote different "state of affairs" encountered in the presumed environment of the observer.

In this context the objects of observation and contemplation must be appointed or indicated, and we have a row of terms at our disposal to name a phenomenon used for the sake of indication. For instance: indicator, pointer, index, address, sign, token, symbol, mark, badge etc., and they all have in common that the essence of the indication lies not only in the indicator's form (appearance) but in its interpretation as well. Once the interpretation is resolved we have, in this situation, at our disposal – not only the indicator’s form – but also a reference to some other phenomenon. Thus an indicator can be seen as the antecedent (forerunner) of an object (an idea), which is derived from the form of the indicator by means of the beholder/observer’s interpretation of this form. Thus when the beholder of a knowledge base successfully can either:

1. Trace the object (or idea) appointed or
2. Apply a useful interpretation to a new indicator

a private connection between an indicator and the appointed object/idea is thus securely established. We normally call such an indicator a sign and we say that the sign relation is resolved (or computed) when the path between the indicator and its appointed phenomenon (object or intent) is established. Mathematically speaking such a sign is primarily a function connecting an indicator’s form with its referent. In its normal use, we think of a sign as only as indicator forms (i.e. classes of object), but this “short-cut” is misleading and for this reason the term “sign”, as used in its traditional sense, remains both ambiguous and highly confusing. As a remedy I will instead use the term ”token” as to specify the form (appearance) of the

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65 U. Eco (1979) uses the term “sign vehicle”

66 One should rather use of the more general term ‘sense’ and we will revert to that later
indicator and the term "sign-function" to address the aforementioned reference function of this twofold functionality of the sign conception, as in normal use.

When we, on the other hand, meet with a form from which no reference relation can be computed such a form must be considered to be the non-token. Evidently such a "form" stands for itself only and is a "form" that does not even invite any mental associations. For reasons of information economy one is led to believe such "forms" simply are ignored/forgotten by a contemplating mind and therefore simply "vanish" in due time. This is a process of submergence that strikingly contrasts the emergence of a "new" sign-function with its twofold interpretation of a token and its associated reference connection.

Saussure (1916) described sign-functions as a dyadic relation between a token (signifier) and its referent (signified). Pierce, on the other hand, described sign-functions in a triadic manner as an object-interpretant-token67 relation in which a token stood for an object and to an interpretant "in some respect or capacity." For a more thorough account see Noeth (1995) p. 79. Peirce called this triadic relationship the object-interpretant-token semiosis, and since he was a realist, the token, for him, can be said to be mediation between the world (objects) and understanding (interpreants) in some practical context. In the next section we will closer elucidate the difference between the dyadic and triadic relation.

As already mentioned, Peirce (1931), gives a more comprehensive and fruitful treatment of semiotic entities and expands his view into a general metaphysics. From Peirce’s viewpoint the token concept reads "something which stands to somebody for something in some respect or capacity", and such a definition establishes that the token and model conceptions are synonyms. Thereby he also consolidated the well-known triadic relationship attributed to Ogden and Richards (1923) and known by the name the semiotic triangle68:

![Diagram of the semiotic triangle](image)

which Peirce in (1931) explicated as:

![Diagram of the semiotic triangle](image)

which is often is considered similar to Frege’s (1892):

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67 Peirce rather used the term “representamen”
68 We here use a mirrored form of this triangle to adjust to the meta-model of modelling
In science the human observer is the obvious interpretant and we here note the striking analogy to the triadic relationship below, and the 2-step meta-model of modelling (to the right below) as proposed in Collected Paper No 1 in this thesis:

However, in the SOA the reality and its objects will “vanish” (in the guise of some pre-given intent of human knowledge) and instead another type of meta-model emerges, where the mental impression is explicated by two modelling processes and the use of two models:

This two-legged figure, however, lacks of the "base line of interpretation” because the symbolic model here portrays the subject’s mental impression rather than some "thing of a pre-given reality.” However we will still call the left-hand leg, with its striking projection phenomenon, the perceptual path and the right-hand leg as usual the presentational path

Contemplating these two figures we understand that both a symbol and a model “stands for something else” here and for this reason we can adopt semiotics and Eco’s definition of a sign (ibid. p.16):

A sign is everything that, on the grounds of a previously established social convention, can be taken as something standing for something else.

This definition connects to the semiotic tradition but is, however, in need of considerable shaping up. This will be done in several steps to further explicate the terms in use and at the same time remove the confusing repeated use of the terms “everything” and "something.”
First of all we note this definition is dyadic – it simply tries to connect /something/ to /something else/.
In other words we here miss the interpreter (or observer) – the existence of which is very obvious in Peirce’s most elaborate definition:

A sign, or representamen, is something which stands to somebody for something in some respect or capacity. (Ibid §2.228)

The latter is a triadic relationship (see the figure on the previous page) where the interpretant phenomenon of the interpreter is very obvious since ”the sign stands to somebody for something.” To restore the Peircian triad we accordingly insert the missing “somebody” - namely the observing subject:

A sign is everything that, for some interpreter, on the grounds of a previously established social convention, can be taken as something standing for something else.

We avoid the previously mentioned confusing use of the single term “sign”, in favour of the dual conception of a sign-function and its embraced token:

A sign-function is everything that, for some interpreter, on the grounds of a previously established social convention, can be taken as a token standing for something else.

The “everything” that connects a token with “something else” is in model theory called a graph and after such a substitution and we can suggest the following model of the semiotic sign-function:

A sign-function is a graph that, for some interpreter, on the grounds of a previously established social convention, can be taken as a token standing for something else.

The sign-function essentially connects two tokens by means of an established convention - see the figure below:

![Sign-function diagram]

We have now come to the end of the road, extending and extracting the essentials of Eco’s somewhat involved definition of a sign and have found that ”sign” is short for ”sign-function,” i.e., a relation connecting two tokens by means of a convention used by an interpreter. The figure above reveals that the sign-function is a relation that is very close to the mapping function as used in mathematics and in next paragraph we will see the sign-function is rather a generalisation of the mapping function. A graph is a set of relations connecting the elements of a source domain to the elements of a target domain.

![Graph diagram]

In this situation we speak about the ”original” source token that maps into a ”copy” called the target token and in this situation we are also able to define a forward mapping direction. We note here that a given source token can be part of many different sign-functions. So an observing interpreter e.g. can connect a ”given” source token to several target tokens by the use of different conventions. In this way we can easily establish a set of conventions (for interpretation) that are to be used in different contexts. For instance the point-token is in physics, conventionally used to appoint locations in space and time, material particles, atoms and so on depending on the actual context.

By the serial interconnection of two sign-functions we can readily re-establish the previously mentioned meta-model of modelling with its characteristic perceptual and presentational path, in a way that reveals its close similarity to the semiotic triangle:
Without further ado we now understand that the proposed meta-model of modelling can be interpreted as a *structure of two connected sign-functions* and this point of view will be contrasted to the traditional realist’s model in the next section. To avoid confusion when discussing this structure, we will avoid using the terms source token and target token, since the upper node of the semiotic triangle is both. Also the specification of certain "mapping directions" will muddle things up and we will instead identify the tokens in this figure by the names *s-token, m-token and r-token*. The s-token (sense or subject’s token) is the abstract token appearing as a mental impression, the m-token (model or marked token) is the sign vehicle and the r-token (reality token) is the phenomenon we, in classical thinking, normally call the "object of reality.” We note here that, in terms of classical thinking, we disregard the intermediate step of the mental impression (s-token) and the "object of reality" is rather thought of as the source (original) object mapped (along the dotted line) onto the model or the target (copy) object, where both belong to a physical domain.

We also note that Eco connects the token to /something else/ – by means of social convention – and not by means of topological mapping, as often envisioned in mathematics, a relation that connects the /original/ and its /image/ on the basis of visual similarity. We will see that this allows for a more flexible notion of sign-function and that the use of the somewhat unspecific term /something else/ virtually sets the sign-function free from the importunate "essence-question.” In the definition as given hitherto we cannot, however, take a percep for a token, because a percep is a private phenomenon, and Eco’s specification “on the grounds of a previously established social convention” clearly is intended for collective use. And here is, parenthetically, the point where classical thinking leads us astray, which we will understand when we ask the question:” Who is the one to determine what is the social convention in use?” This is a question of agency and since Eco’s sign-function is merely for consensual (inter-private) use and based on a social (collective) convention whereas here we are mainly looking for the “social mind.” Furthermore in this definition we understand a *private token* does not qualify as a part of a sign-function and this is unsatisfactory. However Eco’s reason is obvious, since the topic of semiotics is the *cultural processes as processes of communication* in his view, i.e., rather the topic of semiology as defined by Saussure. For that reason the processes involved must be supported by an underlying (collectively agreed-upon) system of signification. Thus the project for semiotics, according to Eco, is to study the whole of human culture and take the view that an immense range of "objects and events" are sign-functions as "defined” by a social (collective) convention and which can be used in processes of communication. In such endeavours the function of private conventions and habits have little importance. However, this situation does not licence us to leave the agency question in the way Eco and most realists do, because private conventions are not at all disconnected from social conventions. As a matter of fact we will finally discover that the idea of "scientific objectivity” can be restored by tracing out how a set of private conventions are allowed to grow into social group conventions. What is more, Eco points out that the rules of established social conventions are very often tacit – if not to say concealed – and if we choose to rely on some hidden social conventions this will make the situation even more problematic.

Pierce, and we aim for more, and see no reason to exclude perception from processes of signification, and by removing this exclusion we *make a token (mental impression) the primary phenomenon in human conceptualisation*. To adjust to the SOA we thus introduce the notion of *private token - a sign-function for private use* - connecting a mental impression to its referent, which, as a first approximation, is a truly private concept. For consistency with semiotics, we slightly modify Eco’s definition for the cultural domain above to make it fit for use in the private domain:

69 After all the prototype of ‘mapping’ is the relation between the nature of the grounds and its drawn map.
A private sign-function is a graph that, for the observer, on the grounds of an established private convention (habit), can be taken as a token standing for something else.

We note here that there is no principal difference between a private convention and a social convention since they only differ in the respect that a single individual follows a private convention whereas a social convention is followed by a group of individuals. In doing so we have fully established the path to Peircean metaphysics, specifying that a private habit can also give rise to a sign-function and its associated token. The notion, here introduced, of "an established private convention" spontaneously makes one think about a piece of private experience – that at a later stage can be part of a consensual convention. From this viewpoint, each mental impression is nothing but a token, involved a privately established sign-function - the token of which displays the "featureless world" to us. Furthermore all there is to this "world" – are such tokens and as such they function as placeholders in a "simulation’s game of thinking.” At such a level of thinking we need no information about some eventual ontological essence of the objects, a situation that is very well captured in Eco’s definition when he specifies that the token stands for ”something else”, i.e., some other phenomenon. As a matter of fact, we have previously concluded that no such information is available to the human observer. It is important, however, to note that Peirce was a convinced realist. He defended a pansemiotic view of the universe:

A man denotes whatever is the object of his attention at the moment; he connotes whatever he knows or feels of this object, and is the incarnation of this form or intelligible species; his interpretant is the future memory of this cognition, his future self, or another person he addresses, or a sentence he writes, or a child he gets.” (ibid. § 7.591)

and in the same spirit the SOA defends a pansemiotic view of each man’s private universe – the priverse. Also in Peirce’s view, signs are not a class of phenomena apart from other nonsemiotic objects: "The entire universe is perfused with signs, if it is not composed exclusively of signs" (Pierce, 1931-58, § 5.448), and by this move he liberated his thinking, as Husserl did, from the essence-question – however they both in their souls believed this “world of signs” to be pre-given and accordingly singular.

U. Eco (1979 p.165) incidentally makes us aware of this Peircian use of tokens:

There is a brief passage from Peirce (5.480) which suggests a whole new way of understanding real objects. Confronted with experience, he says, we try to elaborate ideas in order to know it. "These ideas are the first logical interpretants of the phenomena that suggest them, and which, as suggesting them, are signs, of which they are the - interpretants.” This passage brings us back to the vast problem of perception as interpretation of sensory disconnected data which are organized through a complex transactional process by a cognitive hypothesis based on previous experiences (cf. Piaget, 1961).

In the next passage Eco sets out his view on the structure of these mental tokens in terms of “cultural units” that in the early stages of conceptual thought was obviously “private habitual units”:

Suppose I am crossing a dark street and glimpse an imprecise shape on the sidewalk. Until I recognize it, I will wonder “what is it?’ But this “What is it?’ may be (and indeed sometimes is) translated as “what does it mean?” When my attention is better adjusted, and the sensory data have been better evaluated, I finally recognize that it is a cat. I recognize it because I have already seen other cats. Thus I apply to an imprecise field of sensory stimuli the cultural unit “cat.” I can even translate the experience into a verbal interpretant(/I saw a cat/). Thus the field of stimuli appears to me as the sign-vehicle of a possible meaning which I already possessed before the perceptual event.

Such “cultural units” are in computer science called “conceptual models” that derive from the conceptual schemata in use in both computer and the cognitive sciences. Through this remark we begin to understand how the human mind is able to “dress the presumed outside reality by the imaginations of mind.” The experienced observer equipped with a set of cultural units (conceptual models) and provoked/guided by the clues from outside selects the appropriate set of cultural units with which to set up the “present stage play.” “Clue patterns” that cannot be fitted into either cultural units or private habitual units are thus either approximated or simply ignored. The analogy of a child setting up plays on a puppet theatre, outgoing from a given set of puppets (theory), is striking and illuminates the ongoing act of perceptual construction. From the subject-oriented view this process of construction takes place on the perceptual path of the semiotic triangle, and this process is alien to perception in its traditional sense since this is mostly a process of neural
modelling. The "clues from outside" merge with human knowledge in the creation of the colourful and vivid mental impression – *that makes the "world" seen as through the lenses of our earlier experience – appearing in the form of mental impressions*. In the following we will see this picture of human perception take form.

1.4.6 The model function.

Firstly, we will dwell on the realist’s view of scientific and enterprise modelling that is mainly substantiated by his/her model of human perception. From this viewpoint, the very “source of the system modelled” and the result of the modelling process – the model - have long since been regarded to “be the members of” a pre-given and unitary world inhabited by things. This “furniture of the world” is further regarded as being composed of matter that is immersed in a space called “physical” because it is considered to span a domain defined by physical action movements, as proposed by Poincaré (1905). In this realistic view it is assumed, as a consequence of tradition and guided by the sense of touch, that there is a "real world out there" – called the real world or reality – that is perceived mainly by the human senses. Further we assume that this “real world” is portrayed (or mapped) to human awareness in the form of "perceptual images" that are juxtaposed to the mental impressions occurring in human mind. This situation is dealt with at length in Collected Paper No 1. This approach gives rise to the well-known and sometimes awkward scientific dualism, the view that there is one original – the “outside” thing – and its "inside" duplicate or copy – the mental impression. Collected Paper no 4 deals with this situation. The TTP, that is the artificial scientific meta-perspective that was prescribed as the correct scientific viewpoint at the time of the scientific revolution gives rise to this view, and my claim is that an imprudent use of the TTP is the root of many of the difficulties met with in science during the 20th century.

As a contrast Collected Paper No 5 claims that we, in spite of the claims of traditional science, as human beings live in a situation where the FPP is the only perspective at our disposal. This view reveals that we live in a monistic world, which we will also find by reduction of the semiotic triangle in the coming section. The claim is that the scientific observer in this situation, in spite of the insistent claims of the prevailing realist’s doctrine, has access only to one phenomenon – the mental impression – an idea previously advocated by Helmholz (1878). In this situation, there is, as Collected Paper No 5 shows, only one option left for the build-up of consistent scientific knowledge – the SOA.

To pave the way for this understanding we must resume the pursuit to understand how the majority of mankind came to believe - and still believes - in a solid pre-given reality and on this very ground became irrevocably trapped in the traditional view of dualism. We need to carefully investigate the basis for the most central points of the realist’s doctrine that are also supported by the traditional object-oriented thinking adopted by science. We must ask, where on this path to or from a presumed "real" worldly domain to the "unreal" mental domain of human awareness is this real/abstract transition supposed to take place? What we are really doing in this situation is that we, in parallel with Descartes, are claiming that the extended "thing" is the "pre-given original" and the non-extended mental token a "secondary derivative" of this very "original." What are the grounds for such a claim? In this section we will therefore begin to seek an answer as to why we consider the presumed "thing of the world" to be more "real" than or at least different from the (mental) token of it. In other words we will ask on what grounds the real/abstract dichotomy is introduced. Is this habit just a remnant of the naive man’s belief or is this contested distinction a scientifically useful one?

In the last paragraph we gave up the misleading sign conception for the more consistent denomination of a *sign-function* that relates a *token* to */something else*/ in a way that is specified by a *graph*. We specify:

\[
\text{sign-function} = \langle \text{token}, \text{/something else/}, \text{graph} \rangle
\]

In model theory a *model* is also something that "stands for something else" and this relation is generally explicited by a graph, and in this manner we understand that the model conception suffers from a similar confusion as do the sign conception, inasmuch these two supposed simple concepts reveal an underlying hidden complexity. For instance, we say a model aeroplane, when we think of the very object (the token) of the full-scale aeroplane, and thereby often forget that the graph is part of the model specification in the same way a graph is part of the sign-function. Accordingly the relation between an aeroplane and its model should rather be called a *model-function*. We could very well say the *sign-function and the model-

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70 Realizing that the thing is an allusion the mental image is all there is to my knowledge
function are very similar, as are then the terms token and model, and at the same time we point out that the terms "sign" and "model" are just the shortenings for sign-function and model-function respective. We find that these functions are used in different contexts only:

\[ \text{model-function} = \langle \text{model, /something else/}, \text{graph} \rangle \]

which is to say the model-function is just an instance of the more general sign-function.

However there is an important and partly hidden difference between the model-function and the sign-function, namely the fact that we use the term model to indicate a "physical" phenomenon (a physical mark-of-token) whether in the sign-function the term token also is used to denote a non-physical phenomenon. That is that we note that the upper point of the semiotic triangle – the s-token – is an abstract phenomenon that is strictly private and as such part of some idea, illusion or percept that can be communicated only after its successful explication into a physical mark-of-token. For the sake of explication and communication we therefore must "transform" the abstract s-token into a physical m-token. Following the Cartesian characterisation the s-token is a non-extended phenomenon and we must therefore ask whether a non-extended phenomenon also is a non-physical one. We will therefore in the following ask what is the difference, if any, between a "tangible", "perceptual", "physical", "extended" and "real" phenomenon and as an aid in addressing this issue we find reasons to once more consider the semiotic triangle and in particular the situation on the path of perception.

1.4.7 The semiotic triangle

In section 1.4.5 we pointed out the parallel between the semiotic triangle and the proposed meta-model of modelling - see figure 4.1. The semiotic triangle fig. 4.7.1 is a token relation that relates the r-token (a) and m-token (c) to the "unseen" s-token (b). This triangle is a schematic presentation of the tokens appearing in the percept of a super-observer observing the observer to the right hand side of the figure. In this impression one can find percepts of the object (a) and the model (b) and a woman head that contains an "unseen" s-token. We attribute this triad of tokens to occurs to any observer and accordingly also to the woman in figure 4.7.2 We thus find reasons to complete the meta-model of modelling according to figure 4.7.3.

The realist’s claim is that both (a’) and (c’) are "real", and we are interested in the motive for this claim. This claim gives rise to the realist’s model of perception namely that (a’) and (c’) are the causes of (a) and (c) and it is unclear as to whether this "real" attribution is due to their "outsideness" or some other ontological feature possessed by them. It is even unclear as to whether the real/abstract distinction is scientifically useful.

Assume that there is a mental domain - then we conclude (a), (b) and (c) are all mental, so all tokens on the semiotic triangle are mental. We find (a) and (c) are perceptual and (b) more "abstract", since we cannot even visually capture (b) in our own awareness. Thus when we place ourselves in the place of the observing subject, assuming the FPP, we once more find that (a) and (c) are simply perceptual impressions. We once more find, as explained in detail in Collected Paper No 5, that all living beings are confined to the FPP, i.e., all we have at our disposal in observation is the evidence presented to us through our senses - nothing more and nothing less. As a matter of fact the realist and the anti-realist are almost agreed on the point that (a), (b) and (c) are all mental impressions. The deciding difference is that the realist
holds that the regularities observed in the perceptual phenomena (a) and (c) must have an "outside" reason (cause, explanation), and they seek this reason, which they call the substantial forms (or natures) of the objects involved in natural processes, i.e., the realist holds a secure belief that the two tokens (a) and (c) are caused by some phenomena (a') and (c') that are "real", contrary to the mental/abstract tokens appearing on the semiotic triangle.

Taking that stance the realist maintain the idea that human knowledge can transcend the uncertain perceptual evidence presented to him by the senses, and as matter of fact he seemingly takes one imprudent step further: He takes the token (a) for the thing (a'), which furthermore is called "real." For that reason we must investigate the significance of the real/abstract distinction and in which way a human percept could contain information as to whether (a') is "real" or not. In the lack of such evidence the "real" attribution simply seems a persistent confusion of mankind.

The SOA, on the other hand, claims the two entities (a') and (c') are transcendental because human knowledge can never with absolute certainty transcend the circled boundary given by the human senses. We will be better prepared to understand this involved situation, the two different perspectives of science and the relation between the dyadic and triadic token relation in a regular use in semiotics when we redraw the semiotic triangle in the following two steps (fig.4.7.4):

Figure 4.7.4

Here (a) is the percept (the r-token), (b) the subject’s s-token and (c) the percept (the m-token), i.e., the model as presented by the subject. Thus (a) and (c) are both "perceptual" and as a first step (I) can therefore be redrawn into the figure (II) displaying an "abstract" and a "perceptual" domain. We adjust the triangle (II) in a second step, as even the view (II) explicates the s-token as a visual impression, which is not correct. From this view there is only one domain of visual experience – portrayed by figure (III) – since the s-token is also invisible to the subject. In the FPP we no longer find a triangle, all there is, from the realist’s view, is the percept (a) of the "original" object and its "copy" (c) – the model. They both appear in a strictly perceptual domain, and this is precisely what we as first person human beings find when observing a worldly "real" thing and its "real" model. The entities perceived are simply perceptual impressions – the underlying causes (by hypothesis) that make up the core of the realist’s "real thing" are non-perceivable – as then is also the "real" thing.

As a matter of fact we also find that the realists are in need of two percepts for the effective evaluation of the model since a direct comparison in situ is impossible in most cases. Contemplating figure (III) we find that it is possible to “conceive likeness” between an abstract s-token (the idea) and the "perceptual" m-token (the "image" of the thing) because we evaluate likeness by comparing two perceptual tokens, i.e., we compare a percept of a "thing" (r-token) against the percept of its "model" (m-token). As a matter of fact such a comparison seems extraordinarily reliable since the sense stimuli regarding perception will pass one and the same perceptual mechanism of the observer – so that eventual defects of the mechanism will cancel out in the comparison. The possibility of such comparison was one that once greatly bothered Berkeley (1710) – but for other reasons:
But, say you, though the ideas themselves do not exist without the mind, yet there may be things like them, whereof they are copies or resemblances, which things exist without the mind in an unthinking substance. I answer, an idea can be like nothing but an idea; a colour or figure can be like nothing but another colour or figure. If we look but never so little into our own thoughts, we shall find it impossible for us to conceive a likeness except only between our ideas. Again, I ask whether those supposed originals or external things, of which our ideas are the pictures or representations, be themselves perceivable or no? If they are, then they are ideas and we have gained our point; but if you say they are not, I appeal to any one whether it be sense to assert a colour is like something which is invisible; hard or soft, like something which is intangible; and so of the rest. (Berkeley, Principles 8)

However, the situation explained here reveals one serious snag to the realist – namely the comparison of two mental impressions (two tokens) and certainly not of two "real" objects. The motivation behind the realist’s introduction of the real/abstract distinction is however still lacking. However, the realist can also find comfort in the idea that any two ”real” objects, if there are any, can be compared through their mental impressions. When we understand these two conjectured ”real” entities are compared in the guise of a comparison of their tokens we have, thus, dealt with Berkeley’s misgivings.

1.4.8 What is a "real" phenomenon?

In the realist’s philosophy it is widely supposed that every object of awareness falls into one of two categories: Some things are ”real” in the somewhat uncertain sense of the physical71; the rest are subject to human imagination or ideation and are for that reason called non-physical or mental. The latter are on similarly uncertain grounds, further subdivided into abstract, non-extended, imaginary, illusory etcetera. This means we have to work with a set of distinctions such as the real/unreal, concrete/abstract, material/mental, extended/non-extended etcetera that are not only uncertain but also significantly overlap each other. These distinctions are supposed to be of fundamental significance for metaphysics and epistemology, but nevertheless due to their uncertainty72 they have a curious status in contemporary philosophy, since there is no standard account of how these distinctions73 are to be explained. In the absence of such accounts, the philosophical significance of these distinctions remains uncertain, and we are, as a consequence, directed to classify things as real or unreal only by appeal to human intuition. For ease of dicussion, we will compile all these distinctions into one, namely – the real/unreal distinction and the reason for this move will become evident later.

The opposition between idealism and realism, which is generated from the real/unreal distinction, is as old as philosophy itself, and can be traced back to the time before early Ionian science (see section 1.2.1). The participants in the early developments of science adopted the primitive myths and the naïve man’s view that the fundamental stuff of nature was “tangible” are therefore more ”real” than human illusion. The realists held that conceived regularities of the natural phenomena must have a reason (cause, explanation), and they sought this reason in their properties, constituting what they called the forms of nature or the essence of the diverse substances involved in natural processes. The nominalists, on the other hand, who denied the special ontological characteristic of such properties, were in a position to reject such requests for explanation in their reality description, relying only on the existence of universals such as names.

There are deep on-going philosophical disagreements about the general structure of scientific theories and the general characterization of their content. A generally accepted current view, made popular by Sellars and Quine, is that theories account for observable phenomena by postulating other processes and structures, but some of them are not directly accessible to observation (hidden variables). The phenomena of interest are in general described as entities (or systems) of any sort and can be described by a theory in terms of its possible states (of affairs). The behaviour of these entities is captured in terms of properties and interaction.

Anti-realists or instrumentalists, in most cases rely on the form that rational construction of a scientific theory should take. Realists, on the other hand, revel in the life praxis of science and insist that in a developed theory, basic category terms are intended to refer to real objects and events, while the theoretical laws are intended to be true in a correspondence sense about these objects. In that sense truth decisions lies at the centre of interest in the realist’s science. The real/unreal distinction that is the basis of scientific realism has, on the other hand, curiously enough just received renewed interest and Mackinnon (1979) points out:

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71 Descartes made a distinction in res extensa and res cogitans
72 Not to say confusion!
73 For a survey see www.plato.stanford.edu/abstract objects.htm
As logical empiricism died the death of a thousand qualifications, the moderate ontic realism, developed in different ways by Quine and Sellars, became the reigning realism. Neither admits of any first philosophy prior to science in determining what is real. Nor does either admit of a doctrine of de re necessity or any irreducible reliance on modal logic in analyzing scientific laws. Ontology comes in chiefly through a pragmatic theory of acceptance. One who accepts a theory as explanatory should, to be rationally consistent, also accept the entities postulated or presupposed as indispensable in these theories. (Mackinnon, 1979, p. 502)

From that view functioning physics and human language praxis presupposes the reality of particles, atoms, and molecules as a framework of pre-given concepts, a solid construction which quantum mechanics then denied. Such sayings explain the common usage, but neither asks nor settles the question of what it means for anything to be "real." It would be consistent with the position presented here to hold the view that physics depicts a phenomenal world in Kant's sense, where the essence of phenomena is truly circumstantial. The realists, on the other hand, are insistent in their claim that one cannot either do or adequately reconstruct physics without treating atoms and particles as "real" physical existents—handily setting aside the risk of taking the tokens (traces) of quantum physics for the "real" thing.

Accordingly the realist, seemingly on the basis of a firm belief, regards the "things of the world" to be "real" and then he/she, probably led by figure 4.7.4. (III), also concludes that models are "real", because the r-token and m-token both appear in the "same" domain. The realist probably fails to see that he or she by accessing the "unreal" perceptual impression of the "things" (and their models) and nothing else, and therefore has no useful basis for a real/unreal distinction. We must further investigate the tenability of this distinction, for the reason that the SOA, in contrast, concedes that all the tokens of the semiotic triangle are perceptual and therefore should all be considered mental. Of course the realist, in this situation, could also choose to fend this off by claiming that the s-token is also "real", but such a move will only make all mental impressions "real" rather than explaining the common real/unreal dichotomy in use.

The "real" conception as used in traditional science is thus somewhat fleeting and in most cases "real" is said to basically pertain to that which is not imaginary but rather existent and identifiable as a thing, state, or quality. Such saying, however, do not improve the situation since we have no means to separate what is "real" from what is "imaginary." Such a move would therefore merely establish a real/imaginary distinction that is as undecidable and useless as is the real/unreal distinction.

This discussion has, however, indicated that the identification of a thing, state or quality is nothing other than the identification of a token (mental impression) of a thing, state or quality. When we, as thinkers, also believe any such token to be paralleled by a phenomenon in a non-imaginary domain, we exhibit the firm belief in a "real" domain that complements the more "unreal" knowledge domain of mental impressions and in doing so we tacitly accept the dualistic view advocated by scientific realism.

How do we so easily hasten to such a conclusion in such an important issue? Well, stones are "tangible" and therefore "real" as well as "perceptual" and we through intuition claim we have "solid" evidence for this opinion. However, on second thoughts, this idea is not very useful since we also generally consider "light" to be "real" and from that viewpoint the term "perceptual" would seem a better characterisation than "tangible", were it not for the fact that illusions would also appear as perceptual phenomena. However the "reality" of the stone percept is confirmed by the sense of touch and we can then perhaps come to the rescue of the realists by claiming that a "real" token is rather a confirmed "perceptual" token. The idea that a "real" and a "confirmed perceptual" world should be synonymous also sounds promising and we will gather some useful strands concerning scientific methodology discussing this idea. Therefore the next step is to ask if a "real" token could simply mean a token that has been perceptually confirmed? Yes, once upon a time this probably was the situation. Common practice tells us that what is approximately "touchable" is also "real" and accordingly the sense of touch is used on a regular basis to check whether a visual impression is "real" or not. This suggests that the interpretation that a "real" thing is a phenomenon perceivable by the human senses has been the subject of confirmation. However physics has nowadays unilaterally widened the domain of "real experience" to embrace—not only what is perceivable—but the entire domain of what is "physically measurable." Thus physics leads us to believe that a "physically measurable" phenomenon is a "real" one and that measurement is a process that can differentiate the illusory from the "real" event or thing.

The next question that must be addressed is how the physicists know what phenomena are physically measurable. The immediate answer (as a matter of fact the only one available) is: By means of the prescribed
praxis\textsuperscript{74} of physics, i.e., the praxis of scientific observation that as a rule also includes processes of confirmation. In this way we readily find that the "real" question is brought back to the process of physical measurement, and further consideration shows us that this characterization comes very close to the everyday usage of the term "real" as used even in the non-physical sciences. In the praxis of the natural sciences we usually say that a phenomenon capable of provoking a measuring instrument is a "real" one. So let us therefore try a provisional definition such as:

In the praxis of the natural sciences we usually say that a phenomenon capable of provoking a measuring instrument is a "real" one.

Since most of the phenomena that have the capacity to provoke the human senses also are measurable such a definition includes the cause of human sensation in the category of "real" phenomena - and hopefully rules out only the illusory ones.

When using this definition we must further note that the situation whereby a phenomenon is "physically measurable" is juxtaposed to the "real", in fact enables physics to be the ultimate decider regarding what is "real" or not. Through this very move science virtually denies the "unarmed" human the possibility to decide on what is "real" or not – and science has unilaterally appointed itself to be the super-decider regarding this important question by means of their dedicated spokesmen - the physicists. However to decide what is "real" or not, if there is a useful distinction to find, should not be the task of physics – but rather metaphysics in its sense as a science evaluating the activity of other sciences - including physics. As a matter of fact when we, in this situation, refer to the praxis of physics for a decision in the real/unreal question, we refer to a \textit{subjective group decision made by physicist}. Such subjective decisions are unscientific according to the prevailing Newtonian paradigm\textsuperscript{75} that the physicists themselves claim to so strictly adhere to. Nevertheless this situation will fortunately cause very little harm, since we will finally discover that the domain of human knowledge cannot successfully be separated into a "real" and "unreal" region.

We have found that "real" is the physicists name for a phenomenon that is able to provoke some physical measuring instruments capable of producing a "reading" and giving rise to an r-token as the final product. Accordingly a "real" phenomenon is seen as the cause of the r-token and defines a causal connection between the "real" thing and its r-token. However we may note that the r-token is merely an immediate token on the way to the more abstract s-token. The realists furthermore, and this is important, claim that the phenomenon causing the r-token is "real" – in contrast to the "unreal" mental phenomena. This is the essence of the realist’s claim. From the above discussions, we understand that the praxis of physics will tacitly provide the definition of "real" – by means of the phenomenon’s ability to provoke a measuring instrument. So is the prevailing situation, even if this definition is deeply involved in the evolutionary process of physics, and therefore somewhat fleeting. However even this line of thinking cannot answer the question as to whether the real/unreal distinction is useful or not – since we have only now learnt how the science of physics has become the ultimate decider regarding what is "real" – a situation that clearly explains why the movement of "scientific realism" became the dominant one at the time of the scientific revolution. It still remains to be discovered whether or not the "real" characterization is useful for science or simply a burden to it.

\textbf{1.4.9 The realist’s model of perception.}\n
We must rather seek an answer to this question in the model of human perception as maintained by science. This model is almost congruent with the realist’s model, which is part of the more extensive doctrine of realism and here the basic idea is that the presumed original and "real" thing, through perception, maps onto a "reduced and faded copy" that is most often called a "mental image", see figure 4.10.1. For a fuller account see for instance Collected Paper 4. This model is essential in the development of modern set theory and the characteristic definition of a function as used in mathematics emerges from the topological mapping process inspired by classical geometry. This process of mapping is often regarded as a "process of abstraction" a denomination that tells us that the perceptual domain is also regarded as an abstract (unreal) domain in the realist’s framework of thinking. From this point of view the realist, very much guided by the

\textsuperscript{74} see Mackinnon (1979) p. 503

\textsuperscript{75} Apart from the exception of quantum physics
naïve man’s view, maintains, without foundation, a real/unreal distinction as he claims the "outside" thing to be "real” opposite to the "inside” mental impression. The real/unreal transition then, according to the realist’s proposal, seems to occur somewhere on the path from the "outside” thing to the mental s-token. Contemplating figure 4.7.3 we understand that (a) is a perceptual impression of the "real” object that gives rise to an "image-like” r-token, i.e., the subject’s knowledge of a presumed thing that must not be confused with the eventual "real” thing itself.

Since the perceptual impression (a), at least in the case of sight and the eye’s retina, belongs to "res extensa” according to Descartes’ famous distinction, this view suggests that the real/unreal transition takes place somewhere on the perceptual "brain-internal” path between (a) and (b). The approach of this thesis is to show that this "transition” is mainly an attempt to uphold a real/unreal distinction introduced at an early stage of science. We will claim that if science finds such specification to be required, it occurs on the path between (a’) and (a). Since (a’) will prove to be unknowable we propose here that, for practical reasons, we can also exclude "real phenomena” from scientific modelling. This means that the "real” attribution is invalid, which e.g., make statements such as “X is real” undecidable and senseless.

Some realists claim, in contrast, that all phenomena are "real”, which then essentially states that the term "unreal” is not part of the knowledge domain – and in this case they parallel the subject-oriented claim of a monistic knowledge domain. Then the real/unreal discussion reduces to a discussion as to whether this knowledge domain should be called a "real" or "unreal” domain. In this situation we will show that the knowledge domain is more correctly characterized by the term allusive. On the other hand we will show that it is hypothetically possible to hold onto the classical idea of an outside real domain – with the restriction that the constituting entities of this domain are unknowable in principle.

In short in the following we will ask:

1. Is there a consciousness-outside "real” domain?
2. If so, can the eventual objects of this domain be subject of certain human knowledge?
3. If not, what is then the essence of the "unreal” human knowledge?

We will show, in the following, that certain human knowledge recognises only one domain – the allusive domain of epistemology – we will certify that the "world” and its denizens is almost an illusion – which we therefore prefer to call allusions. On these grounds we find the traditional idea of the real/unreal distinction as decidable, to be not only useless but also severely misleading.

We will show that the concepts of a "real world” and with a "real” furniture are uncertain and in this situation the question “Is X real?” reduces to an undecidable pseudo-question, regardless of the actual reference to X. This is actually the demise of realism, which unfortunately does not validate anti-realism (illusionism) either. However a knowledge culture involved in discussing undecidable questions is unscientific – and cannot be called a science for the simple reason that it resorts to unfounded beliefs. Uncertain concepts build uncertain knowledge – and uncertain knowledge is not the basis for any certain science. When we, on the other hand, strive for certain knowledge about an uncertain world, we can form the core of consistent human science.

So the rejection of the "real” conception and scientific realism does not mean the automatic acceptance of anti-realism since the use of the term anti-realism also then becomes unscientific. When we try to explicitly specify that the anti-realists doctrine reject the usefulness of the real/unreal distinction, we simply find that anti-realism also rejects the scientific use of the term anti-realism. The basic problem is that the real/unreal distinction is undecidable, as are more or less all the other confusing distinctions that we previously compiled to form the real/unreal distinction. Human understanding recognises only one certain domain – the domain of allusions – and from that view the real/unreal, concrete/abstract, substantial/nonsubstantial distinctions and others turn out to be plain confusions as will be shown.

We can, as a matter of convention, specify that the "world is real”, which from the subject-oriented view makes my private knowledge "real”, but at the same time, we specify that we, as living beings, share a common ontological world. Such a world can no longer be considered to be "real” any more, since we cannot specify whose private knowledge should be regarded as the common one - see e.g., the citation by Wheeler & Zurek in section 1.4.15. When we, on the other hand, specify that the world is allusory (non-real), this move makes my knowledge allusory (and possibly private), and then we can without contradiction specify the ontological world to be both common and unary – but unknowable.
Here we find, and this is important, a more conclusive trait in the realist’s model of perception, since when the realist regards the r-token (a) to be the "image" of the "outside" thing he claims the "thing" to be ontologically pre-given. In this way he considers the "worldly things" to exist and have properties in a way that has nothing to do with the actual observer situation in charge, i.e., that he happens to observe the thing. He claims that even if the observer is removed, the thing will still exist. This is clearly a claim of an existence that is observer-independent, i.e., the thing will exist even in the eventual absence of the observer, and this claim is characteristic for scientific realism. In this case the thing is said to have an ontological existence. So far, so good - but then what about the associated perceptual r-token (a)? In the case where we remove the observer, the r-token will clearly also vanish. So even if we consider the thing to be ontologically pre-given its associated perceptual r-token (a) is not – since the r-token is in need of an observer in order to emerge. The cognitive sciences have, also, presented us with substantial evidence that perception is a skill that requires a lengthy training, and that the existence of a "pre-given" thing does not even secure the occurrence of a human r-token even in the presence of an observer.

In figure 4.7.2 the left-most path is the perceptual and the right-most is the presentational path and the deciding difference is that the latter is a path of action, where the s-token is, through action, transformed into a "real thing" (c') (or a token vehicle) that can be perceived in the guise of the m-token (c). Since (a) and (a’) and (c) and (c’) are percept-thing pairs figure 4.7.3 can as a first step be simplified into:

Two serially connected sign-functions where from the realist’s view the thing is the cause of an r-token (sense impression), which in turn causes the s-token. Since here we are discussing the relation between real and unreal phenomena and the usefulness of science’s real/unreal distinction, we are interested in where this crucial transition takes place, if anywhere. The realists find the real/unreal "transition" to occur somewhere on the path between the thing and the s-token, but it is unclear where and we will later see that there are very good reasons for this confusion.

First of all we find the s-tokens denomination of a "mental image" disturbing. The mental domain is "non-extended" by the traditional Cartesian definition, so how can we then ever speak about a "mental image?" In this thesis we have therefore called this "image" a "mental impression", but, by thus doing, cannot draw away from the fact that such a token cannot possibly be likened to an "image" or an icon. The term "impression" in the term "mental impression" or sometimes "imprint" as in "mental imprint" are both chosen so as to refer to the idea that something presses or impinges, i.e., acts upon human awareness and thereby produces an s-token. However the resulting product of this "pressing" or "impinging" is entirely mental and whatever this may be it cannot be perceived by the human senses, for the simple reason that here we are "behind" the perceptual domain of the r-token. On the other hand we by subjective evidence feel it and we can therefore specify that an r-token can provoke a mind to produce an s-token. We provisionally consider the mentioned act of provocation to be a mental one and will, in the coming sections, try to find out what is the significance of such an act. We thus specify that an s-token is a train of mental provocations – or in short a complex of human feeling.

It is also important to investigate the realist’s claim that the thing is "real" or at least in some sense categorically different from the s-token. To avoid a discussion about the choice of the term "real" we have hitherto summarized this claim into the statement that the status of the thing is different from that of the s-token and that this difference in some way concerns the things status of existence – its ontological status. As has already been pointed out, we, from the naïve man’s view, can find several good reasons for the opinion that the thing is "real", but as scientists we cannot without further ado merely reproduce this view. The Collected Paper No 5 considers this situation at length and finds conclusive reasons to reject both the realist’s doctrine and the OOA, as used in the Newtonian paradigm. In an attempt to strengthen the

76 However it is frustrating to involve in a discussion those to whom this existence is secured.
penetrative power of these findings, we will contemplate the situation regarding the path of perception anew, because the realist and anti-realist\(^\text{77}\) view clash when following this path.

As repeatedly stated the realist’s claim that the thing is "real" and, as a contrast, the s-token is not. These two sets of tokens are connected by a graph visualised as a process of mapping frequently used in topology. The realists cannot provide however an explanation as to how such a "real" phenomenon transforms into a "mental image" – as they are unable even to offer a satisfactory explanation regarding the essence of the doubtful conception of a "mental image" frequently referred to. Nevertheless, since the target domain of a topological mapping process is most often considered an "image", we now at least understand the reason for the confusing use of the term "mental image." On the other hand the "real" attribution seems, in some mysterious way, to be lost on the way from the thing to the s-token, an event that is usually hidden under an unspecified "process of abstraction.” So then we ask if "abstraction" is part of the "mapping process"? Apparently not, since the realist, on the presentational path also makes use of a similar "mapping process", where rather a "process of de-abstraction" or "physicalisation" seems to take place. Apart from this somewhat unclear position, it seems evident that somewhere on the perceptual path is the place where a veritable miracle\(^\text{78}\) occurs according to the realist – the "real" thing "collapses" into an unreal (abstract) token that belongs to the mental domain of human consciousness - a veritable paradox as conjectured up. We are interested in discovering the reason for the rise of this paradox and the semiotic triangle will be very useful in resolving this dilemma. We will, to our surprise, find its seed deeply buried in the realist’s model of perception that makes up the core of the traditional Newtonian paradigm – in the guise of an intricate decision problem hitherto disregarded by the convinced realist.

**1.4.10 Can we know the objective world?**

In this section we will continue to discuss the realist’s model of perception (fig. 4.10.1) and in this traditional model the object of observation is, through its existence, taken as "pre-given" to the observer. In our quest for the real thing, we must therefore next ask whether or not such a "pre-given-ness" is what the realists take for "real." In the traditional world this view of the total collection of "real" things is identical to Nature, which also is generally considered "pre-given" to mankind either by God or the Process of Evolution and are on these grounds considered unquestionable. Embracing this idea we accept the principle that the idea of a "pre-given" Nature stands under (is the foundation of) the very knowledge science can build upon through human observation, which is the first contribution to the experimental methodology. The principle of the "understandability of Nature" as brought to the fore by Schroedinger\(^\text{79}\), who evidently takes Nature as "pre-given" to human knowledge and a piece of knowledge that traditional science can successfully build upon. From that view a "pre-given” phenomenon means a "certain" phenomenon and the realist, perhaps through the notion "real", refers to such a "certain" phenomenon that cannot possibly be doubted because of this "certainty."

Now the question of certain knowledge reduces to a decision problem and we must ask whether or not such "certainty" follows from the "pre-given-ness" of logical necessity or it is just a matter of human belief. Let us somewhat rephrase the question into: When we assume a phenomenon to be "pre-given" and "certain" in this very sense, could it then be that the knowledge we extract by the observation of this "pre-given"

\(^{77}\) The reason for using the realist/anti-realist dichotomy rather than the realist/idealist or realist/phenomenalist will be evident later

\(^{78}\) Stapp (1993)

\(^{79}\) Collected Paper No 6 p.12
phenomenon also is certain? This is a quest as to whether or not the human observer can build knowledge that is certain and this situation can be readily investigated by examination of a "pre-given" s-token, i.e., an experienced provocation.

Let us assume that a private mind experiences a token\textsuperscript{80} T, in the form of a state transition marked on a scale of, say $0 \rightarrow 1$. As a next step, we ask what a mind can say about such a provocation. Is this provocation "induced" by some "mind-outside" phenomenon as part of a process of observation or by some "mind-inside" phenomenon, e.g., a mental spasm? Contemplating the perceptual path (Fig 4.11.1) of the semiotic triangle we find that in order for a mind to come to a \textbf{certain decision in this matter there must not be any feedback circuits on the perceptual path – not even a single one.}

Should it be that the perceptual path is in some way feedback connected, e.g., as in fig 4.11.2, then it is in principle impossible for the observing subject to reconstruct a presumed r-token, i.e., the hypothetical incident stimuli input. The feedback contribution FB will eventually add to or transform the incident stimuli input and unless we have a complete knowledge about FB (a perfect model) a reconstruction of the r-token is impossible. Such a feedback connected brain, in principle "is free" to append\textsuperscript{81} transitions, on the perceptual path at their own "will", so to speak, and are accordingly added to the resulting s-token. In this case we must say T is an illusion. Furthermore, we find that a "pre-given" outside a state transition can very well transform or even "disappear" through conceptual feedback, resulting in the absence of an s-token, which also results in an illusion. We find that unless FB is a very simple linear deterministic function any experienced s-token T is uncertain. This is part of a poorly understood process that in the modern cognitive sciences is sometimes referred to by saying for example that "perception is theory-laden."

This line of reasoning clearly applies to each state transition being part of a more complex s-token in human experience. Thus when we assert that a mental impression can be approached as an s-token, we also assert that every part of the s-token can be approached as an s-token down to its smallest part, i.e., the state transition when using the state space approach. In conclusion any group of state transitions is uncertain and accordingly any property and even thing description. Then also the "form" of the impression that is supposed to reveal the "form of the thing" is uncertain – and this form property is crucial both to everyday human and scientific understanding. \textit{On these grounds, we find that a feedback-connected brain is unable to reconstruct an original pre-given stimulus, and the realist model of perception is mistaken. What is more important, however, is that in this situation, the assumption of a world "pre-given" to the observer is also a major mistake. In other words we can state that unless the overall function of FB is very simple and known, a living observer has no means whatsoever to decide whether or not the s-token (percept) derives from something "pre-given" or is simply a personal imaginative invention (spasm).}

The modern cognitive sciences, however, have revealed that the perceptual path between the eye and the centre of human awareness is an intricate neural network housing a rich feedback functionality, which effectively contributes to the brain’s learning capacity. In this situation it is possible, even in principle, for a brain, totally disconnected from some "outer world", to produce a "mental movie" – a free running solipsistic mind - simply by means of perceptual feedback, which, of course, is then a suggestion about what happens during processes of free imagination, dreaming and hallucination. In this situation Descartes’ nightmare seems to come true, since we cannot now convince ourselves that we are not always dreaming. \textbf{Whether we like it or not, we are hopelessly caught in a solipsistic observer situation and as a consequence we are forced to abandon the realist’s mistaken model of perception.}

No observer, starting from an experienced s-token, can reconstruct the original "pre-given" stimulus it hypothetically derives from, which means the features of the original stimulus is unknowable in principle. This is the essence of Kant’s saying that "das Ding an Sich" is unknowable in principle – and we are bound to conclude that even its very existence is uncertain.

Here we find an important facet of the "real" conception that has very little to do with the ontological status of the phenomenon of observation. This is a \textit{quest for certainty}, and in this case we are asking whether or not, we as observers starting from the s-token, i.e., our private knowledge, can make a \textit{certain reconstruction} of the "actual" r-token that is present for observation. We have shown this is impossible for a feedback connected single observer, and so is also the case for a group of such observers - and accordingly also for science. This is the inevitable conclusion.

\textsuperscript{80} A pointed out earlier a s-token is a mental provocation

\textsuperscript{81} E.g., we know that the ‘blind spot’ of the human eye is corrected for in this way
The important point is that it is impossible to reconstruct the "actual" r-token, and uphold the realist’s model of perception, in a situation when there is a feedback loop on the path from the r-token to the s-token and as a matter of fact all phenomena as pictured before the feedback loop (to the left-hand side in the figure) are uncertain in this case. Since the research on human cognition and neural networks has shown that there are a multitude of feedback loops in a human brain, it is an apparent mistake to speak about an actual or "pre-given" r-token in term of certain knowledge – as is the talk about a world consisting of "pre-given" things endowed with certain "pre-given" properties.

For the reasons mentioned, neither can the provocative "clues from outside" be considered as being certain, however we can still consider them "real" in the sense of "outside" even if they are not certain. Such a "real" phenomenon is called transcendental as it transcends the grasping power of human knowing – and must rather be approached by an intelligent guess. In this situation the "clues from outside" are in fact identical to the "real" phenomena endowed with the capacity to provoke the measuring instruments of physics. This might sound strange because we claim the "real" phenomenon to be the both uncertain and measurable at the same time, which contradicts the practice of physics where the measurable phenomenon is regarded as a certain one. However this is not a contradiction since this simply has to do with the change in perspective. To the "outside" observer the "real" is the certain phenomenon, but to the "inside" observer the "real" is the uncertain, and the deciding factor is that we have shown the first perspective to be mistaken. This is the knowledge we can extract from this very situation and from that view all knowable phenomena are tokens and when we choose to keep up the traditional real/unreal distinction we conclude that all tokens are unreal and the rest "real" and unknowable. We are reminded of Locke’s words:

General and universal are creatures of the understanding, and belong not to the real existence of things. To return to general words: it is plain, by what has been said, that general and universal belong not to the real existence of things; but are the inventions and creatures of the understanding, made by it for its own use, and concern only signs, whether words or ideas. (Locke 1689, Book III,iii,11)

We will later see a "real" phenomenon is not unknowable because of a lack of information but rather due to inseparability, and further find that the human brain by experience learns to make an intelligent s-token guess guided by the provocative "clues from outside" and rather than not fully fortuitous82 and this is the reason we prefer to call this guess of the s-token an allusion. However, even if evolution has furnished the human brain with the means to make such decisions in "worldly" matters highly probable, it does not change the fact that the idea of getting to know the "furniture of some common (or objective) world” is gone forever. All I can know is my priverse that is made up entirely of allusory (unreal) phenomena.

In the case where we stick to the traditional real/unreal distinction we are now in the position to answer the question: “What is "real"?” The simple answer is: A "real" phenomenon is an "outside transcendental" and therefore an "uncertain" phenomenon. Such phenomena essentially belong to a domain of hypothetical entities that must be addressed by guesses and probability statements. Due to the feedback connections of human brain such a "real" phenomenon is in principle unknowable – because the "real" contribution of the allusion cannot be separated from the mental contribution by means of observation. This means that human observation is unable to feature the "appearance” trait that is so central in the “what is”-question, see e.g. Chisholm (1957). This also means that the observer in the FPP has no decision procedure to enable a decision to be made as to whether a phenomenon is "real” or unreal – or "outside” or "inside.” Therefore these dichotomies are scientifically useless unless redefined. We cannot even make reference to the praxis of physics simply because instrument readings are also in principle transcendental. The human knowledge domain (the semiotic triangle) is made up of "unreal" and "inside” phenomena – and since we cannot know the "real" and "outside” phenomena we must either conclude that science deals with "unreal” phenomena, in the sense of allusions or reject the usefulness of the real/unreal and outside/inside distinction and take each priverse as the obvious ground for consensual agreements based on a describable (but unobservable) common model universe.

Now we have an answer to the second question asked above: If there is an "outside” domain it cannot possibly be the subject of certain human knowledge.

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82 To be 100 % illusion
1.4.11 The construction of "reality."

This insight reveals an even more serious flaw in traditional Newtonian thinking, namely that it is grounded on premises that are fundamentally mistaken. The realist’s model of perception is mistaken in the sense that the r-token cannot be considered to be pre-given in the build-up of human knowledge. Accordingly human consciousness cannot be considered to be involved in the mapping of ontological reality as classically envisioned, but rather in a process of guided construction, where the allusive s-token plays the central role. In this new situation we have to face the fact that the present s-token is the only token "given" to the subject observer in his build-up of knowledge. This means we must reverse the direction of causation in the realist’s model of perception. It is the mental impression (i.e., the biological guess of s-token) that is "given" to the observer in the build-up of knowledge instead of some presumed "pre-given" thing. This is so because the clues from outside are "hidden" and transcendental and therefore beyond the reach of certain knowledge. Such phenomena can at best be approached as probable phenomena.

The all-pervading problem here is that to accept the proposed subject-oriented view we have to set our thoughts free from the classical idea that we as living beings have access to a "pre-given" world in the sense of a "certain" one. We must accept the idea that even if there should be a world ontologically pre-given to us – we can never in principle know this world for certain. Instead we must be content with what is given to us in human perception – the s-token – which now emerges as the only given phenomenon and the take-off point for human knowledge build-up. Whether the private s-token is certain or not in relation to some other phenomenon is something we have to deal with at a later stage. Entering upon this path we can at least be certain that the realist’s "outside" thing is transcendental and therefore unknowable. The situation is in fact symmetrical, if we take the real thing for given (as in the OOA) the s-token is uncertain and when we take the s-token for given (as in the SOA) the transcendental thing is uncertain. However, as already been pointed out, the perceptual feedback of the human brain produces a situation where there is only one alternative left - to take the s-token for given at the moment of observation - otherwise we are totally lost since the realist’s thing cannot even be accessed by human knowledge. If we acknowledge the confusion caused by the "outside observer" we find that the s-token is not only the one "pre-given" in the moment of perception - it is in fact the only phenomenon available. This should not surprise us greatly, since this is the very situation we face on an everyday basis since the mental impression (s-token) is attested to be all there is to human perception – but it does. No living being can be an "outside" observer, which means nobody can be an "objective" observer. Once we understand that nothing "outside" the human mind is "pre-given" to human knowledge at the time of birth, we will understand the crucial role of the s-token and will also be ready to accept the projection process being in charge in human perception as suggested by the SOA. Then the present state of scientific confusion will cease.

On closer reflection, the SOA appears as the only sound approach to human knowledge build-up for two reasons. Firstly when we take the s-token as a certain, we start the build-up of certain (private) knowledge that, of course, in the long run can prove to be "only" probable. Nevertheless in this very situation I am certain that my private knowledge is just probable – which indeed is a certain ground for a consensual agreement on this issue. The route to a consensual agreement is straightforward since this line of reasoning applies to each living individual. Secondly, should it be that we can show that the human brain in all sensory

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83 Uncertain in the sense of illusory
channels are feedbacks connected by simple linear functions\textsuperscript{84}, the SOA will explicitly and consistently show the validity of the traditional OOA and the Newtonian paradigm. However quantum physics has already shown that such a conclusion is very unlikely and we have also already forewarned that the OOA is invalid, a situation that validates the complementary SOA.

1.4.12 The subject-oriented model of perception.

The SOA uses a different model of human perception and suggests that the solution is to abandon the realist’s model of perception for an approach that fully acknowledges the only perspective a human being has at his/her disposal – the FPP. What, in the SOA, is given to the individual subject in the build-up of knowledge is the s-token and in this situation there are no reasons to assume that an "outside" provoked s-token is the same or even a similar s-token in another individual as each brain is "feedback programmed" by the experience of each individual. We must abandon the idea that each s-token is private and thus paints an "allusive world" that is strictly private – an idea that is in force even to the individual pioneer or scientist of prominence. Viewed from that perspective, the existence of an "objective" mind with the divine ability to perceive an "objective world" seems very ill founded and, most of all, sounds like a reverberation of the God’s Eye View - a view that should be totally ungraspable to any human being.

The root to the realist’s mistaken model of perception is that we, even as scientists, tend to forget that we are third person observers when looking at figures 4.7.1 and 4.7.2. The r-tokens of these figures are nothing other than percepts and contemplating figures 4.7.1 and 4.7.3 we find that all the tokens on the semiotic triangle belong to the human knowledge domain. And after all any token must, as part of a sign-function, be "internally" accessible to the interpreter. From this viewpoint a "real" phenomenon is transcendental and when we chose to keep up the real/unreal distinction, all the tokens on the semiotic triangle are "unreal."

From this point of view all "real" phenomena are unknowable, which once more confirms the findings of Collected Paper No 5, that we cannot possibly abandon the role of being "inside" observers. Also H. Everett (1957) has shown that any attempt to divide a closed universe into two parts results in state descriptions that are observer relative, i.e., are related to his private awareness.

Previously we concluded that the "essence-question" was of subordinate importance in the schema of science. However the achieved success of science, as witnessed above, has also told us that its activities have not suffered greatly from the lack of an answer to that question. Now we have, furthermore, made it clear that it is impossible to obtain an answer to the "essence-question", which accordingly is undecidable. With this insight in mind we have to re-evaluate what we can achieve by scientific thinking. The "real" is the "transcendental" and we accordingly find the ontological reality "hides" in a transcendental domain. We can by way of perception, neither say, with any degree of certainty, what the "objective world looks like" to an eventual deity nor draw any other certain conclusions about its features. We must abandon the realist’s model of perception in favour of the one suggested by the SOA that will now be done in stages.

Firstly, in fig 4.12.1, the realist’s thing is unknowable and its features "disappear" in the new model of perception, where the location is marked by the clues from outside:

Secondly, since the observer’s perceptual mechanism is feedback programmed by private experience each mental impression is private – constituting a knowledge priverse as a collective. This is what I momentarily see and feel – the relative s-token – which is related to my knowledge

\textsuperscript{84} The brain is proven to perceptually transparent so to speak
Thirdly, in fig 4.12.2 we must explain how the s-token "appears" as an allusion outside awareness, even outside the human body. The reason is a brain-internal projection process that conceptualises (make into a feeling) the distance to the clues from outside. We can say that the s-token through this process of projection literally by means of a "dressing" process disguises the clues from outside — that are accordingly unknowable as inseparable parts of the allusion.

In this SO-model of perception we find that the phenomenon we normally call a thing (which above all is the feature of the thing) is the s-token that by projection alludes to the clues from outside. Observe that the clues from outside are sort of anchor points in an allusive (imaginary) space — in a "space feeling" - that is the feeling space of my priverse. Such an anchor point is a mind creation computed from an s-token under the assumption that this s-token is a unification of two slightly different r-tokens.

The ease the understanding of this projection process causes us to imagine that the observer’s mind first computes a "feeling complex" — the s-token — which it "hangs" on the hook of the anchor point of the feeling space. This world of allusions is truly private constructions that constitute my priverse, which as such becomes the "visual" - or rather sensational - means to guide my actions. We find that this process of modelling is an important contribution towards providing the human intellect with an instrument panel for action decision. This is an important function of human consciousness.

We then remind ourselves of a new facet of scientific uncertainty — that is different from uncertainty as appointed by Heisenberg, that the allusions are bare creations and private ones and in no way can be seen as elements for the re-construction of an objective reality. From that viewpoint, we have to re-evaluate the logic of science, in parallel to renewing the conceptual build-up of scientific knowledge. The layman will probably experience the hardest blow by recognising that mankind can never find out "what the world really looks like.” Since we, from this view, cannot know the ontic things, neither can we describe nor speak about the unique and common world that is probably ontologically pre-given to us — or in the words of Wittgenstein (1922): “Whereof one cannot speak, thereof one must be silent.” However, we can speak of their tokens — and this is sufficient. We can, as a matter of faith, believe that a world is ontologically "pre-given" or not, however we cannot, from an s-token, securely reconstruct such a state, property or thing to specify a common world — called a reality. In conclusion we cannot securely attribute states, properties or features to entities of such a transcendental world.

In the previous sections, we have found that the allusive s-tokens are mostly creations of a private mind and this we state by saying that perception is perfused by imagination. Since human experience modifies the conceptual feedback loops of brain through learning, there are also strong reasons to believe that perceptions change as the observer’s knowledge grows.

In the two latest sections we have shown that we cannot accept the realist’s model of perception due to the non-linearity of the neural feedback of human brain. Here is not the place to resolve the causes of this non-linearity; it is sufficient to understand that the classical model of perception basic to the Newtonian paradigm leads us astray in some respects:

1. The clues from outside are uncertain, which makes the idea of the existence of an "outside world" uncertain. From that view the "real world" reduces to a hypothesis where the phenomena must be approached by probability assessments.
2. Even if there should be a unary world ontologically "pre-given" to living beings, the features of this world are not reflected in our observations of it, i.e., the features of the eventual "objective" reality are hidden to human observation.
3. The doctrine that the mental impression through a mapping process somehow denotes or "pictures" the essence of things is unwarranted, i.e., the assumption that the objects of perception are independent of the perceiver or the process of perception is invalid.

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85 If the s-token should appear in the mind such distance information would be lacking.
Quantum physics has already shown that the process of observation at the quantum level influences the object of observation and in this respect the very process of observation delimits the knowledge that can be extracted by observation. However, we now also find that the "appearance" of the mental impression is dependent on the observer's private perceptual mechanism and in this situation we might ask whether or not it is, in this situation, possible to even produce a model that can be used for inter-subjective human communication.

As a summary we now have given answers to the first and second questions of section 1.4.9 namely:

1. Is there a consciousness-outside real domain? - Maybe.
2. If so, can the eventual objects of this domain be subject of certain human knowledge? – No.

However this does not mean we cannot know anything. We still are able to build knowledge that can be the certain base of probability models. The starting point is that "inside" phenomena are certain. E.g., my existence and knowledge is certain, but in the case where I want to participate in a social community I will soon discover that I must be prepared to adjust this knowledge (learn) according to the established social conventions. In this way I learn to know the privirese in terms of the social conventions of communication, i.e., learn to describe the privirese in terms of common languages.

Based on the subject-oriented view of the "world of entities", this is an "inside" world (priverse) and the names and attributes we use to describe this priverse refer to the s-tokens, i.e., the private mental impressions we experience respective. The next step is to indicate how the s-token can be taken as the basis for a set of social conventions that allow for effective human communications regarding the content of this s-token, i.e., we will try to answer the third question: "What is the essence of the "unreal" human knowledge?" and facilitate this discussion by asking what is the s-token of a cat.

### 1.4.13 What is a cat?

As a result of the above discussion, we find a new principle that totally contradicts the realist’s thinking, namely that the cause of the s-token in principle cannot be reconstructed and the "world as perceived" is accordingly a plain allusion. We have also seen that from this point of view the individual s-token is the only certain starting point for scientific conceptualisation. This idea, however, deeply upsets the trained scientific mind as we are, by tradition, taught to regard the world as "pre-given" and certain and the dual mental impressions as uncertain. However, in this state of indignation it is very rewarding to ask: *Is there really anything more certain to a thinker than his or her own ideas?* In asking so we, in the spirit of Descartes, take benefit from asking: "Is not my very "thinking" the only token of something "certain" I have – i.e., the only phenomenon I cannot possibly doubt?" When we are prepared to discuss this alternative then my thinking - and their tokens – will turn out to be my only certain "reality", in the guise of my collected experience both in perception and thinking. What else there then might be, i.e. the cause of this experience, is from that viewpoint, plain guesswork that takes on the form of a set of models that constructs a world of apparent entities - an allusive world – which in spite of, has turned out to be an effective tool for prediction and contemplation. Mach, Pierce, Husserl and others have suggested that a consistent science must be built on these ideas - and furthermore the SOA has indicated that this path is the only possible option.

We have to reverse the direction of causation, since based on that view the "clue pattern" of provocation in no certain way portrays some "worldly thing", but rather mentally conjure up the "remembrance of a thing" in the observing individual. This remembrance is most of all a chain or network of knowledge associated with the actual clue pattern in question. The reversal of causation is a crucial change to science and unfortunately it is extremely difficult to adjust one’s thinking to this new model of perception. Based on this view, the allusive world is constructed from "inside" to "outside" by means of imaginative projections (set of models) that are the allusive suggestions of some "outside" that as such is unknowable (transcendental). Since the dawn of science we have taken these perceptual allusions (s-tokens) as the certain indicators of a "pre-given" world and as such they have been called the "things of the world. " This "thing is nothing but the s-token projection – this is the very essence of the mentioned process of projection and the subject-oriented model of perception. Furthermore, due to the primacy of subjectivity this s-token is strictly

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86 We will later see that perception and thinking are inseparable.
87 The Collected Paper No 5
private. So the visible form and other properties that we, in the classical view, have attributed to the clues from outside are, based on that view, **identical to and nothing more than the s-token involved in a process of projection**. In exactly the same way the uncertainty that adheres to the allusive thing, so to speak, is nothing other than the projection of the fuzziness adhering to the s-token, which is a **fuzziness that pertains to the knowledge of the observing subject** rather than to some transcendental "world.”

We will now enter upon a path that will show that each s-token that emerges by provocation is a projection (remembrance) that encompasses the subject’s accumulated experience of past s-tokens of the "same kind" that substantially reduces the time of the process of recognition.

For the ease of discussion let us contemplate the situation when I see a "cat", i.e., my awareness focuses upon an s-token (a set of feelings) that in recognition find reasons to mark it by the term "cat." Thus an s-token /cat/ is identified in my awareness through a process of cognition. The categorical term "cat" attached to this s-token is the "category name" of this identified entity, i.e., an m-token. This name has its origin in an utterance – a sound that some historical subject happened to utter struck by the feeling-complex of /cat/ in awareness. Because of frequent use this feeling-complex → name association has, over the course of time, received a consensual status. Such a name is called a symbol, and this m-token stands for the s-token impression of /cat/. As such "cat" symbolises (stands for) the subjective judgement of /cat/.

To utter the name "cat” means that the thinking subject feels the /cat/ s-token which can be an allusive cat (he or she thereby suggests an affirmative connection to a suggested entity in a transcendental world) and by pointing to it I take advantage of the allusion that probably emerges in another observer. Through this act of communication I can here simply refrain from modelling my allusion. In the situation where the other subject receiver happens to be absent I say: “Yesterday I saw a cat” and thereby I refer to the social convention of a cat, i.e., the receiver’s remembrance (s-token) of a /cat/.

In conclusion a /cat/ is then a sort of “conceptual schema” – a “mental matrix” specifying the attributes associated with a /cat/ according to a private or social convention. However this is not the “conceptual” schema of cognitive or computer science, since such schema is evidently an m-token - but nevertheless is fairly close to it. The s-token is a complex of feelings, and specifying the “mental matrix” to be a grouped pattern of points produced by the perceptual mechanisms of the brain is the closest to a description that can be made. Each group of points (field) codes an attribute that I call a “property of the cat” and since I have the feeling /cat/ my perception positively affirms the identification of /cat/, which I can confirm by saying “I recognise a cat.” In this process of identification the form/shape attribute has a crucial role, since human beings in this task heavily depend on visual impressions.

However the realist says: "The cat is like this or that…" and thereby attempts to attribute some properties to the “real” cat, but since this is a transcendental and unknowable phenomenon a significant mistake is thus made. Impressions are endowed with qualities mainly during the passage of the brain’s tissues and only s-token impressions have properties. Therefore this reference in the SOA instead connects to the mental matrix of the s-token named /cat/. Each field in this mental matrix is a specific “feeling” extracted from the incident provocation (alternatively the result of a more circumstantial physical measurement), which I in further modelling specify by some quantity of a feeling (quality).

The s-token /cat/ is thus a matrix whose elements specify the sensations, affects and measurements that I experience when the s-token /cat/ is actual in awareness. We find /cat/ is a complex of weighted data and by establishing a practical situation that gives rise to my private /cat/-complex and ask a fellow being to join me in this situation I hope to provoke the private /cat/-complex of this fellow being, whatever this s-token complex might be to him. In this way I can reproduce my own useful association between the term (m-token) “cat” and its s-token /cat/ in the mind of the fellow being – and there is no need for these complexes to be "similar" at all. In this way we have established a situation of learning, accomplishing that the sound pattern “cat” through remembrance will provoke the s-token /cat/-complex in the mind of the fellow being.

Based on that view, nominalism in the sense of symbol manipulation, i.e., the doctrine that concepts, general terms, or universals, has no "real" reference but exists only as names, has several benefits. E.g. the symbolic term “cat” acts as a model of the “cat impression” in a way that is totally independent of the actual size of the mental impression, i.e., works as a distance-independent model. We also find that the symbol manipulation technique makes efficient use of the human cognition capacity and imagination since “cat” models the ”cat impression” independent of the actual spatial orientation.

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88 On this view an instrument reading is a feeling
89 As a matter of fact such a statement is even absurd.
This line of thoughts answers the question: “What is a cat?” – with the answer a "matrix of feeling data" learnt in coexistence and communication, which connects to the term “cat” or another model of cat in the mind of each individual. There is no other possible answer to the question “What is X?” and there is accordingly no other answer to the question: “What is a feeling?” They both make up a set of social conventions that make us able to communicate to each other in the absence of a "pre-given world."

It is important to note that in *models* we describe our s-tokens (ideas). However in the moment we try to make a distinction between an s-token provoked by an "outside" present cluster of clues and one provoked by the "inside" remembrance of some past experience, we pass the borders of legitimate knowledge. The working hypothesis is thus that a provocation from "outside" triggers an s-token, which does not at all reflect some "present state of a pre-given world" but rather the present situation on the "stage of some puppet play."

Such an s-token "contains" present and past experience unified into an inseparable complex and in this way the brain, through feedback adoption, has learnt to extract some traits useful for description and prediction by reference to its own knowledge.

Our brain works with models that are suggestions for the sake of allusion and the "mental form" of the suggestion is highly dependent on the question asked. Nobody can starting from an s-token reconstruct an r-token – as a matter of fact I cannot even remember my own past s-tokens. Just the actual one - /cat/ - that emerges provoked by the hypothetical cat-provocation, which is sort of "computed out of an algorithm determined by my private experience." This is why each priverse is individual – and the "objective" universe reduces to an absurdity.

In this situation one might ask if this means the possibility of a world by feedback "twisted" into madness. However such a question is utterly in vain – and forbidden - because of the lack of a possible answer and responder. The transcendental world is as it is90 – we can, as individuals only perceive the s-tokens. The world of s-tokens is our priverse and due to the primacy of subjectivity we cannot know another person’s priverse. Instead we learn about other person’s experience by discussing experience attaching the "correct" name or model to the provocation at issue.

It is the type of question that decides what type of model to use – in that sense it is the framing of the question that determines the framing of the mental matrix, which in turn determines the answer we can obtain. Thus these schemata also become the schemata of science and can provide us with the answers to certain questions...however none of these models can gain a special status with regards to providing some truth. Our models do not portray the entities of a pre-given world – they simply are decision models. The problem is to furnish these models with the appropriate properties to be useful for the very question at issue – since the structure of each model decides what answers can be provided for. This is a brand new situation, in which we do not derive the /cat/ from some "real-world cat" but the other way around: We construct a puppet /cat/ that we allow to participate in a life simulation (game) that produces some answers. When these answers turn out to be useful this model game can be part of science.

However we must not think of this constructive mind ability as the sign of capriciousness, since here we rather find that the biological brain in the process of knowledge feedback has developed an effective means of adaptation in order to be more flexible in the crucial tasks of knowledge acquisition. Based on that view, every subjective entity corresponds to an unknown "clue of provocation" and when such an entity in coexistence and close communication is developed into a "group subjective entity", i.e., a cultural entity accordingly determined by social convention, we are able to lay out the basis for the consensual science that in future must replace the confused idea of an "objective" science. Such a modification is welcome since the idea of observer-independent perception, on second thoughts, seems to be a feature totally unfit for a human being living under the pressure of evolutionary selection.

For the reason that the world with its things cannot be re-constructed the s-token can tell us little about the eventual "pre-given world" but will rather describe the set of feelings subjective phenomenon /cat/ to be a matrix of feelings appointing a computed subjective pattern of provocations in a feeling space. Where we divine creatures we could possibly find that the "clues from outside" merge with the "allusions of perception" and accordingly reconstruct a divine "objective" world. Then we would probably find that the brain ignores a multitude of provocations – not to mention the signals that in this situation do not even "count as provocations." However we are not divine – we are humans and confined to the inner perspective. We must not be fooled by the fact some provocations feel hard and painful, because this is no reason to

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90 von Foerster
believe that the world is real – or even that such a distinction is possible. This just means that there is a field named "touchable" in the s-token matrix. It is well known that symbolic words also hurt – and sometimes even more.

We do not say there is no ontological world – we have only said that the ontic/epistemic distinction is as impossible as is the real/unreal, concrete/abstract and so on – for the simple reason that the ontic phenomenon (provocation) cannot be successfully separated from the epistemic phenomenon (impression). For this reason the "real" ontological world, if any, is unknowable – the eventual features of such a world of provocations transcends the powers of human knowing.

We can only have hypothetical and probable knowledge about such phenomena and such knowledge must be built on the basis of repetitive data and information, and furthermore such data cannot be the basis for certain predictions. Based on that view certainty is gone forever – we can only be certain of ourselves – but this is sufficient. However we must note that it would be misleading to call the "domain of uncertain provocations" for the "world" or "reality for that sake – because the total set of possible mental impressions is what even the plain man juxtaposes to reality. Repetitive observations and actions make us believe that there probably is an ontological world, and that the SOA claims the provocations that hypothetically create the mental impressions are strictly private. However, we can still as a species come to a common agreement regarding how to describe and predict the happenings of this world on the basis of common languages (models) as a probable world. The idea that reality should be "like" s-token impression is a profound confusion – the s-token of /cat/ is mostly a mental construction and is best described as a symbolic matrix of feelings.

1.4.14 Some further consequences

In the latest sections the claim has been that the feedback path FB in figure 4.11.2 is a more complex but linear function, which inevitably results in the conclusion that human perceptual inferences in general are biased. For a more comprehensive treatment on that issue see e.g., Bennet (1989 p. 4). The feedback path, as modern research on neural networks shows, is "neurally programmed" by processes of learning and the SOA suggest such bias is strictly private, resulting in the assertion that all living beings are very likely to have different percepts when looking at the same thing. Based on this view, priverse and human knowledge are a set of s-tokens collected during earlier experiences and accordingly we all live in different worlds. To the social scientists, however, such a conclusion does not come as a great surprise – but this finding nevertheless disqualifies the realist’s model of perception.

From the subject-oriented view, the most spectacular change is the reversed direction of construction, i.e., the understanding that the s-token allusion paints the world. From this viewpoint many of the perplexing visual illusions met with in the cognitive sciences become easier to explain. To show this is not difficult, but we shall not settle them here and now, we must be content at having pointed it out. From this different worldview we find that the beautiful creation we call the world is an allusion created mainly by the private mind in a way that licenses us to say that our mind virtually paints the world. This insight means radically new approaches to a set of mind processes such as hypnosis, brain washing, imagination, hallucination, and dreaming etcetera. This also means a new angle of approach to ethics and the thinking of human culture since we readily understand that a happy mind will "paint” a happy world – or we can say, even more generally, that a mind predisposed with pleasant feelings will paint a pleasant world, whatever this pleasure even stands for.

The semiotic triangle that explicates different levels of human imaginative thinking really pinpoints the situation. The s-token is the only token given to human awareness and thus the only base for certain knowledge and this very knowledge as a matter of fact defines the knowing subject. This knowledge is, as a first step, strictly private and on this basis a private science can be built in the guise of methodological solipsism. The SOA takes us one step further beyond that point, claiming that the subject is identical to its collected knowledge and this private knowledge is accordingly the agent allusion we call the Self. From the subject-oriented view, unreal (mental) phenomena are knowable in contrast to real phenomena, when we adhere the classical distinction. The mental s-token is private, and regardless of its essence, must be explicated for the sake of communication – either in self-communication or intersubjective communication. The allusion (which is a model and a product of mental action) carries the core of the biological explication of the s-token, whereas we must rely on optional physical action (m-tokens) to establish intersubjective communication.
The realist’s model of perception is mistaken in principle, and this insight has far-reaching consequences for science.

![Diagram](image)

thing → s-token

the realist’s model

First of all we have learnt that an "objective thing" in this situation cannot possibly be reconstructed and can therefore not be taken as "pre-given." This means that we are unable to conceive of an "objective" world as the "cause" (source) of the perceptual sign-function, we find the situation is rather reversed. The s-token is the source and "original" and indicative of the subjective guess of the traditional "thing" that superimposes onto the "clues of provocation":

transcendental thing ← s-token

Connecting to section 1.4.4 we find that the s-token is the stage actor providing the features as "seen" by the private observer/spectator and the suggested connection to "something else" in this situation has to be provided by the observer/spectator in the ground of earlier experience, which make this associative process highly private. Such suggestions are also always fallible and we must also note that a specific s-token can be part of several sign-functions depending on the context of investigation. For that reason it is important to realise that the s-token is always part of the sign-function during processes of interpretation. A token lacking in reference is the non-token and useless to the interpreter.

It is also important to realise that the allusion to the observer "appears in reality" by way of token projection and this as the means to "visualise" (rather sensualise) both direction and distance to a constructed circumstantial "provocation." This process might seem odd to the uninitiated, however in psychology the projection of subjective feelings onto the environment and the presumed object of observation is a well-established phenomenon. The oddity we experience by contemplating this situation is due to the need to leave classical Newtonian thinking, and all we have to do is to realise that a "visual impression" is also a set of feelings. When we recognise that the knowledge feedback occurs in human brain, then there is no other alternative left to science in order to establish an updated model of human perception.

The reversal of the direction of causation is more difficult to cope with – and the idea that the s-token is the cause of the allusion (i.e., the phenomenon the realist’s call a thing) and this change of thinking unfortunately does not come easily. The subject-oriented model of perception clearly shows that the s-token perfectly "maps" and is identical to the "guess of thing" and now we understand why the realist’s reversed and misleading "mapping alternative" seemed so successful – the sign-function projection in disguise was taken for the reversed mapping process. As we are now aware of subject-oriented alternative we must also all consider the realist’s idea that a "thing" should map onto a mental impression highly unlikely. This would mean that the path between the "reality thing" and the "centre of awareness" (s-token) to be "perceptually transparent." This can go, perhaps, for the in between portion of air between the presumed "thing" and the observer’s senses (the eye) but certainly not for the perceptual tissues between the senses and the "centre of awareness", the "place" where the s-token emerges.

In section 1.3 we agreed that science is the production of knowledge, and as such is mainly a set of ideas/impressions defining the consensual knowledge base that we call scientific knowledge. We might then be led to think that whether we regard these impressions to be “copies” or “originals” is unimportant, because this just seems to be a choice of terms. This is not correct however, because when we make a choice in this matter - which is imperative – then we reveal our belief in this very respect. We have seen that when we as realists consider the mental phenomena to be “copies” we undoubtedly put our faith in a special "pre-given world", and thereby also erect the idea that this "world" can act as a "guiding template" in human truth decisions. This belief of course has a deep influence on the whole methodology of science, since we then introduce a causal direction in the sign-function of perception. In such a belief we consolidate the realist idea that the pre-given and visible r-token induces an s-token in the observer’s mind with the traditionally specified direction of causation /clue → s-token/, i.e., a pre-given thing. When we, on the other hand, in the vein of phenomenology regard the s-token to be the "original" we are forced to re-evaluate the
whole build-up of science from its very bottom brick and prepare for a toilsome shift of paradigm. *Science here faces an important choice that can neither be based on the naïve man’s view nor on mere chance.* We must make this choice guided by the late findings of science and in the spirit of open-minded contemplation. We must make a decision regarding this crucial question – a scientific decision and if necessary, we must even be prepared to adjust the very basic assumptions of science.

Figure 4.14.1 make it even easier to understand why the observer needs a model of his/her own perceptual mechanism in order to make a model of the "worldly projections" – because predominantly this mechanism is responsible for the s-token "appearance." This remark connects to the strands of the Collected Paper No 5, and figure 4.14.1 also in a visual way clearly confirms that such a model cannot be constructed by means of observation. We are, as individuals, firmly caught in our solipsistic role, as "inside" observers and methodological solipsism is then the only remaining alternative for a consistent conceptual build-up.

The clues from outside are mental constructs - sort of hypothetical anchor points of projection – that by probability procedures are calculated from repeated observations, giving rise to a probability distribution that can be used to calculate the probability of finding the clue-provocation in a singular observation. The reader familiar with quantum physics understands this probability distribution is given by the famous wave function of quantum physics. And like a bolt from the blue the quantum puzzle seems to vanish.

When we further contemplate fig 4.14.1 and use the SOA, we find that we are artificially able to "move" the stylised "eye", which here parenthetically stands for all the human senses, to the right hand side of the neural feedback loop (fig. 4.14.2), i.e., to place the "receptive cut" adjacent to human awareness (consciousness). We must carefully note that this is only a thought model, but we nevertheless find in this model, that then the human sensations, feelings and affects are treated at the same level of conceptualisation and all appear as *feelings* impinging upon the stylised "eye." Contemplating the function of such an artificial "new centre of observation" we understand this artificial human mind now would in principle be able to construct a model of its own perceptual mechanism. However, and this is important, to our vexation we find this artificial model cannot now separate the perceptual contributions coming from the "outside" r-token from the ones that are produced by the "inner" perceptual feedback mechanism. We now find the reason why human consciousness in its thinking cannot single out (separate) the eventual r-token from the resulting allusive s-token and this is the reason why it cannot be known. We cannot know it because it cannot be separated from the s-token impression and this also goes for the brain’s contribution to the s-token. In this situation we also readily identify the root of Locke’s famous distinction into primary and secondary properties. According to Locke the primary properties were supposed to derive from the "clues from outside" and the secondary properties were thought to be "induced" by human perception – however we now understand that we cannot make such a distinction. Based on this view we also once more find that the traditional distinction we generally make between percepts and imagination/illusions is misguided, an argument that Quine (1951) vigorously maintained – and we find the percept/imagination distinction is as impossible as the real/unreal distinction.

Since we claim that all tokens except the s-token are uncertain and we have declared the idea of a "pre-given" thing (i.e., state collection) to be obsolete and accordingly the idea of a "pre-given" property also appears to be obsolete. We have also previously found that not even the "clues from outside" are certain, i.e., the "anchor point" coordinates in time and space given by the observer in question. What is "pre-given", based on that view, is the idea that the mental impression "might reflect something in the world of the mind" and this idea survives because we find it useful to say that we are able "recognise the /same/ s-token at a later point in time", in supporting processes of confirmation. This fact of a semi-permanent existence in fact also gives us a good reason to "name" the entity in question. We also give names to properties and their values...
and all these phenomena arise only in a human mind – where they are assigned values based on the proper places of the s-tokens matrix by means of physical measurements or personal feeling estimations.

We have shown that the SOA is the only possible option to enable the build-up of consistent scientific knowledge. Based on this view perception cannot even be approximately regarded as a topological mapping process representing some "pre-given" world since the activity of brain is so dominating in the creation of a human percept, a situation that hitherto has been compiled into the approximate saying that human perception is "theory-laden." Contemplating the subject-oriented model of perception we find that, even if we are able identify two different serial processes involved in human perception, the s-token is the only phenomenon that gives features to the "furniture of the world." Since the feedback connected tissues of human brain make these features "appear attached to things outside" the mind, human intuition recommends the use of the subject-oriented "projection model of perception." Based on this approach human perception is a process of neural modelling that is highly adaptive. We find the allusion to be a model among other models and we are once more able to redraw the semiotic triangle, according to figure 4.14.3.

In both the classical and the SOA tokens are the objects of thinking and the s-tokens are associated with "unseen" conceptual schemata (a set of attribute frames). In the realist's approach these are thought of as the "reduced representatives of the presumed real phenomena", i.e., abstraction, and this model of perception must now be abandoned. In the SOA, on the other hand, these "unseen" s-tokens are the very objects of science that are firmly established by schemata fixed by social conventions. This situation very well explains why each normal human being can present a conceptual schema of a “mother” – that is certainly an entity determined by social convention. However, one must not think of this social convention as totally disconnected from human experience – and for that reason the SOA must not be confused with Platonian idealism. The build-up of the conceptual subject-oriented framework relies on a bootstrap procedure that connects to human sense experience. However we cannot become involved in the explanation of such a procedure at this stage.

Nevertheless in the SOA the s-tokens appearing as impressions (or part of impressions) are the entities of thinking - which in consequence builds our entire conceptual domain – the priverse. This token-impression is also identical to the very appearance of the phenomenon that is outwardly projected onto the priverse. In this way the human brain paints a "world" to inform and orient its associated mind. This is part of the consciousness miracle and the very essence of the instrumentalist's worldview. The mental impressions, that are mainly created by the feedback paths of our brains will function as the indicators of an "instrument panel of life" and what the "clues" are "behind" the mental impression, we can never find out. This is an astounding finding to a human being brought up in realistic thinking, but at the same time as the misguided idea of an "objective" reality is removed we are also able to rid ourselves of a set of constructional puzzlements such as e.g., the Lorentz-Fitzgerald contraction.

Let us introduce a variable outside/inside distinction (fig. 4.14.4) – that parenthetically denotes the outside and inside of the system under consideration – we find that the clue, the allusion and the model (m-token) are "outside" whereas the s-token and the perceptual tissues are "inside." Based on that view we can define an "outside" and "inside" domain, that in the case where the system is a living being, corresponds to a real and unreal domain. In the same way we find a set of different names on the "outside" domain, e.g., the material, concrete, transcendental and real as appointed. These terms are all part of distinction that has been regarded as important namely the real/unreal, material/mental, concrete/abstract, immanent/transcendental and perceptual/imaginary. The mental/material distinction is most often equated to the Cartesian cut whereas the inside/outside sometimes is called the Heisenberger cut. We can also find distinctions that even from this viewpoint are uncertain, e.g., extended/non-extended. However when we allow the delimiting circle to vary, it defines the Cartesian cut at the very moment it comes into a point, and the Heisenberger cut more or less at the moment it touches upon the human skin and the senses. However there is nothing in principle that prevents us from expanding this outside/inside boundary to include any group of phenomena – which make the inclusion of the social sciences in this schema seem quite natural.

![Figure 4.14.3](image-url)
However the all-pervading situation is that the real/unreal distinction is undecidable to the observing scientist as are all the other dichotomies here mentioned, which has to do with the evolution of the human brain and is a principal limitation. We might say that evolution has chosen flexibility before "transparent rigidity" or chosen a living adaptable network before a mechanical rigid instrument – this is what separates the brain from the instrument and characterises the difference between an "outside" and "inside" science.

However this figure shows beyond any doubt that once science chooses a fixed boundary the "inside" become inaccessible to "outside" and this is the situation modern science faces today due to the Newtonian paradigm. The only solution to this problem seems to be either to "conflate the inside" by shrinking it to a point and define all phenomena to be "real" or alternatively to "expand the inside" to embrace all phenomena and accordingly define all phenomena to be "unreal", providing that we keep up the traditional real/unreal distinction. However the best solution is to accept the uselessness of this distinction and reject it and in the same vein we will reject all the other related distinctions mentioned above including the realism/antirealism and realism/idealism distinction, since they all tend to reduce science to an endless quarrel of pseudo-discussions.

So it seems science has no choice but to become monistic, but seemingly there is a choice as to whether we should call the phenomena of science "real" or "unreal." However this will not work because we cannot continue to discuss undecidable question – the correct choice is to call the phenomena of science "allusive" and furthermore conclude that these allusive phenomena "is as they are", i.e., give up the vain "essence-question." The allusion is not a part of a distinction and accordingly not the subject of a possible decision.

We find the real/unreal distinction is not only useless - it is unscientific and on the same grounds the realism/idealism distinction is unscientific. However it appears that the concept of an "idea" and "allusion" are very close so what we are really doing here is to accept idealism and proclaim the demise of realism – and this is actually the case. The decisive indication is that we can call all phenomena "real" only in the situation when we "conflate the inside", which is the equivalent to "conflating the mind" and then once more reconstruct a mind-less world, i.e., Newtonian physics. A non-allusory world is not a scientific alternative – it is plainly a delusion that in spite of this works reasonably well in everyday life.

E.g., Schroedinger was well aware of this logical somersault:

... the 'hypothesis of the real world' around us ... amounts to a certain simplification which we adopt in order to master the infinitely intricate problem of nature. Without being aware of it and without being rigorously systematic about it, we exclude the Subject of Cognizance from the domain of nature that we endeavour to understand. We step with our own person back into the part of an onlooker who does not belong to the world, which by this very procedure becomes an objective world..... I conclude that I myself also form part of this real material world around me. I so to speak put my own sentient self (which had constructed this world as a mental product) back into it - with the pandemonium of disastrous logical consequences that flow from the aforesaid chain of faulty conclusions. We shall point them out one by one; for the moment let me just mention the two most blatant antinomies due to pure awareness of the fact that a moderately satisfying picture of the world has only been reached at the high price of taking ourselves out of the picture, stepping back into the role of a non-concerned observer.

but as a dedicated physicist he tacitly accepted the prevailing Newtonian paradigm to turn to other tasks.

The problem of consciousness studies and the paradoxes of quantum physics parallels modern problems facing the axiomatic methods, mathematics, logics and scientific modelling – that seemingly can be summarised by the troublesome situation that the OOA excludes the Subject of Cognizance from its endeavour and take off from an unscientific model of perception. This model misleadingly portrays the path of perception as rigid and perception-transparent – however the perceptual feedback of brain effectively ruins such ideas.
In the subject-oriented approach’s model (SO-model) of perception the clues from outside are projected as anchor points onto the feeling space and the allusive s-token brings out the "thing allusion" onto these hypothetical clues and all this on a strictly private realm.

The SOA makes clear that we can construct and thus model the "thing allusion" but we cannot (re)construct the "behind lying" clues – and for that reason the "outside" clues are called transcendental. We have no access to any "outside" phenomenon instead we have to be content with the construction of an allusive model. When we construct the SO-model of perception we must therefore be guided by introspection – since observation is out of the question for at least two reasons as previously mentioned.

Now when we understand observation cannot yield a true picture of the world, for the simple reason that this world is not accessible there are no longer reasons to condemn introspection from the arena of science. On the contrary we now find that introspection, in spite of its privacy, is a worthy method of science, by now fully on a par with classical observation that is as uncertain as introspection.

We also find there are no reasons to abandon the basic tenets of the realist’s model of perception, namely that the senses being probably in touch with some transcendental world thus providing some input data that are further processed by a feedback connected perceptual path. However, in this new view, we find a more complex pattern of causation and must therefore abandon the idea of functional mapping and accept the idea that the s-token is not representative of the eventual real world – but rather in the form of an impression presents the private mind’s collected experience of classes of entities. The clues from outside by projection and sensori-motor data code the distance and direction to the hypothetical "outside" entity. This projection process parenthetically allows us to maintain the idea that the world is an "outside" phenomenon, rather than forcing us to accept the more consistent idea that the mind is a brain internal lattice automaton hovering like an self-allusion in a feeling space spanned by other allusions. The choice of model has little importance to science as long as it is useful (non-fallacious) and consensually accepted.

In the SOA case we also find a two-step process: A conceptualisation of direction and distance to the allusion is based on sensori-motor data based on the present data of motor movements combined with the intuitive emergence of an s-token – which in a sense is a "mean value" of the observer’s past experience. However we can think of this as a two-step process; as a probable provocation pattern mapped onto the r-token with no intermediate feedback and the "thing allusion" of s-token can be seen as the clue pattern mixed with the feedback signal pattern. However we can never separate the percept from the feedback signal or the incoming stimulus from the feedback and for this reason the "objective" world will remain unknown.

The s-token and the feedback block (FB) of some other person are inaccessible to me because of the primacy of subjectivity and therefore I only have access to the s-token. For the same reason neither I nor anybody else can (re)construct my feedback block through observation - nor anyone else’s. Accordingly we must simply invent a method to construct a consensual model that can be generally accepted. Since all s-tokens are private we are bound to define a consensual s-token as a sort of "mean value" occurring to a non-ontological consensual mind. Such a phenomenon causes no problem in a world of allusions – this is simply the "scientific mind" that is equipped with a set of generally accepted models that has proven to be useful to mankind. These models can be refined to be more useful in certain situations but since evolution proceeds on chance the term useful cannot be juxtaposed to the classical truth.

The two concepts of truth and certainty are anchored in scientific realism that takes the classical bivalent logic comprising only two values for granted. However Goedel’s theorems and the "Haltungsproblem" as treated by Turing have shown the inadequacy of the classical bivalent thinking. On the other hand we have seen that the science of becoming will operate in a milieu of uncertainty in which questions very often turn out to be undecidable. Then there is a need for at least a three-valued logic. Therefore the principle of bivalence has no place in the SOA as clearly indicated firstly by Brouwer (1907) and we must look for generalisations such as fuzzy logic which operate with decision outcomes that are continuous over certain intervals, where the certainty of decisions or predictions cannot merely assume the
values [Certain, Uncertain] but all values within the interval [0,1]. Since observation is a decision and all observations in the future will be afflicted with uncertainty – as have always been – but from now on they will also influence the basic theoretical principles of science.

The feedback of human perception discovered by the modern cognitive sciences is often referred to as the theory-laden-ness of perception, and this concept was ironically enough first introduced by Popper, one of the foremost defenders of scientific realism. Possibly we can capture this situation in the slogan: We see only what we by learning are prepared to see. We can also capture Kuhn’s idea of the paradigmatic faithfulness and the need for scientific revolutions by a slight reformulation of this slogan into: We understand only that we by learning are prepared to understand. This situation can very well explain the difficulty in accepting, or even discussing, the SOA – something that deeply annoyed von Glasersfeldt (1988).

1.4.15 The need for a shift of scientific paradigm

In its role as a means of symbolic presentation of ideas, modelling has traditionally had a very central role in science and enterprise. However we now discover that the model does not really represent a thing as such in the ontological reality, if any, but is rather a means of presentation in human communication. This function will be even more pronounced using the SOA, since this approach indicates that “reality” in the SOA is to be seen mainly as a set of constructed models rather than something universally pre-given. For that reason models will also be increasingly important in research activities that have previously relied heavily on verbal specifications and descriptions.

Based on this view, a spoken or written, natural language is also regarded as a framework of modelling that is used both in science and on an everyday basis to describe the presumed “world around us”, as well as what is in progress “in” human imagination. The choice of language here is of little importance since words are like coordinates. If, for example, we present a theory in English there is a transformation, which produces an equivalent description in Swedish. There are also possible transformations, which in turn are as able to produce distinct but equivalent Swedish descriptions. Such transformations are on a par with the coordinate transformations used in mathematics. In the same way we can change from one conceptual model to another by symbol transformation. To make the natural language more clear-cut, for instance, students are trained to transform verbal statements into logic. An even greater change will occur when we switch from the object-oriented way of thinking/speaking to the process-oriented way of thinking/speaking as used in computer science, since both the traditional subject-verb-object structure of language and traditional human thinking then totally breaks down. A similar breakdown also occurs when changing from an object-oriented way to a subject-oriented way of thinking – and this calls for the developments of new modelling languages – possibly even a dedicated language of science. Bohm (1980), for instance, calls our attention to the present status of scientific analysis that does not work very well in modern physics, and calls for a new, non-fragmentary world view and in chapter 2 in this book he further goes into the role of language in bringing about a fragmentation of human thought. The structure of language, he maintains, divides human existence and its environment into a network of separate entities that are very fixed and static in their nature. He proposes a new mode of using the existing languages – the rheomode – at least as an aid to study the process of linguistic fragmentation and its influence on human conceptualisation.

Equally important is to understand what happens when we use a modelling framework (say natural language) in a foreign domain. Suppose we want to describe a domain of experience, take music as an example, which is, apart from the novel branch of biomusicology, somewhat alien to science. When we speak about music we tend to use linguistic terms that sounds strange and this is not because there is necessarily something vague about music. Music expresses human experience in such specific ways that when you try to find a language to describe the experience the words fall short, and what is failing in that equation is the language - not the music. Music expresses things about human experience that cannot be expressed in any other way - that is why music is so impressive and important a facet of human culture. In that sense music models the “inner” feelings of human beings using a model “language” that seems very special in every respect. On closer inspection, however, music is revealed to be just sequences of sounds (tokens), which in that sense faithfully parallels the spoken language. Still, we feel that the use of musical expressions is very far from pure human intellectual conceptualisation. In his brilliant book “Gödel, Escher, Bach: An Eternal Golden Braid” D. Hofstadter (1979) draws out a set of interesting parallels on this issue.

Human conceptualisation, i.e., the formation of fundamental concepts in which we couch our thinking when describing the phenomena of cognition, is a process of utmost importance that as such defines the
human point of view we call the scientific view. The fundamental concepts used in this endeavour are the tools of de-complexification made available to the scientific community by scientists and philosophers, under the name of a theory or a paradigm (a structure of theories). These concepts “stand under” all modelling efforts no matter what the specific modelling framework (or language) used for specification is. And when well explicated, this “standing under” of a paradigm makes it possible for human beings to under-stand the very language of science.

For that reason a change in the fundamental axioms in a scientific theory (i.e., that we normally call a change of theory) will give rise to new modelling frameworks. In this situation we cannot use the theoretical understanding as developed during the old paradigm in our efforts to understand the phenomena of the new paradigm. This is precisely what has happened after the introduction of modern quantum physics – many physicists have in vain tried to use classical thinking in order to understand the quantum domain. The result is very often total confusion – and the thoroughness of the Newtonian education in that respect presents a veritable hindrance.

The activities within a scientific discipline, or even in certain subdisciplines such as quantum physics are governed by paradigms - some of them openly declared and others assumed more tacitly. However some research disciplines are devoid of such open specifications. They thus lack a paradigm and are not regarded as sciences for that very reason. This situation creates a state of confusion and arbitrariness within the discipline, often resulting in time-consuming and fruitless discussions that severely91 hamper the productivity of the discipline in question. Unfortunately this state of affairs has had even more fateful consequences since it often complicates – for not to say lays waste to - the cross-disciplinary understanding to the point where almost every sound inter-disciplinary effort seems in vain. (See Collected Paper92 no 2)

Ever since the scientific revolution, scientific endeavour has developed towards greater specialization, resulting in the growth of different disciplinary paradigms that, in the case where they are not made open and explicit, are misunderstood. As such they present a severe hindrance to inter-disciplinary communication. Let us take mathematics as an example, a tool used in many branches of science, which may take on many different forms depending on the discipline making use of it. For different reasons, psychology and sociology, for example, usually avoid mathematics as much as possible, and thereby also keep away from the paradigm of mathematics. Since mathematics has long since been the exemplar of rational thinking one might rightfully ask what type of thinking one use instead. The absence of an answer to this question could mean the absence of a paradigm, and the impending lack of inter-disciplinary understanding. One might even call into question the status of disciplinary understanding under such circumstances. Each science is in need of a paradigm, and this paradigm must “stand under” (support) the conceptual frameworks in use in this science – otherwise there simply is no “understanding” to achieve

We can easily identify this disciplinary wrestling with an outdated paradigm in the following words of Wheeler and Zurek:

Beyond the probability interpretation of quantum mechanics, beyond all the standard analysis of idealized experiments, beyond the principle of indeterminacy and the limits it imposes, lie deep issues on which full agreement has not yet been reached in the physics community. They include questions like these: Does observation demand an irreversible act of amplification such as takes place in a grain of photographic emulsion or in the electron avalanche of a Geiger counter? And if so, what does one mean by "amplification"? And by "irreversible"? Does the quantum theory of observation apply in any meaningful way to the "whole universe"? Or is it restricted, even in principle, to the light cone? And if so, whose light cone? How are the observations made "by different observers to be fitted into a single consistent picture in space-time? If these are some of the issues, they lead to other still deeper questions: What is the most productive meaning to assign to the term "reality"? How are we to look at the subject, so mixed in its character, partly well understood-and, as such, the unshakable foundation for all of modern physics - and partly still uncaptured frontier territory? What else is it but an unfamiliar animal, confined to an animal house? (Wheeler & Zurek,1983 p. xv-xvi)

Scientific research is a group activity ruled by a paradigm that is supported by a number of metaphysical hypotheses inspired by the OOA. This base structure of the Newtonian paradigm has for many years, inspired mainly by physics been developed into the realist’s doctrine, which is the basis for the prevailing ”research programme” of science called scientific realism.

91 Wangler, 1993 p.10.
92 See Collected paper No 2: “Does Networking Replace Systems Thinking....”
The working hypotheses of scientific realism are rarely touched upon and have therefore received little interest - but for instance Bunge (1977) lays explicit claims to:

M1 There is a world external to the observing subject
M2 The world is composed of things.
M3 Forms are properties of things

Here we can readily identify the most important traits of the OOA, namely the hypothesis that there is \textit{pre-given ontological world} (M1) well separated and independent of the subject’s knowledge and furthermore singular. On this issue there is no dispute between the two approaches, but the deciding difference is as to whether this external world can be the legitimate subject of scientific knowledge.

The realists claim that this world is understandable (M2) as a pre-given structure of external things that can be described by the pre-given properties (M3) possessed by these things. In addition the realist’s doctrine (which includes the realist’s model of perception) lays claim to a useful real/unreal distinction, specifying that the external things are "real" and understandable as are \textit{structures of matter} whereas concepts are "unreal" or "abstract." Since things are "real" the world is also accordingly real and in the realists embrace the idea that certain knowledge about this world is possible. Such knowledge collected by a process of observational inference is furthermore considered to be \textit{observer-neutral}. The certainty of determination lays out the solid foundation that is expressed in the principle of bivalence celebrated by realism that is furthermore fundamental to classical logic and set theory.

This is a structure of knowledge that has formed the basis of science since the days of Aristotle and based on that view the ontological Nature has been regarded as pre-given to science as God was to the scholastic thinkers. However God’s or Nature’s knowledge cannot possibly certify such an ontological existence - simply because this is beyond human comprehension and knowledge. Based on that view I am my knowledge and my knowledge is all that exists to me. This knowledge is accessible to me in the guise of my priverse which continually changes and expands. From this view we find the Big Bang of my priverse at approximately the time of my birth and in the same vein we find the Big Bang of our consensual universe (i.e., the universe of science) at the birth of mankind’s knowledge. What else there is – is plain allusion.

This thesis has brought to the fore the claim that the idea of an ontologically ”pre-given” world by means of human observation, which can give rise to certain scientific knowledge is probably a mistake. The suggested reason is that the feedback loops of the human brain prevent the reconstruction of any set of incident stimuli, regardless as to whether this set is organised into a ”world”, ”thing”, ”property” or a single token transition. These items and their structural connection are accordingly private constructions and the behaviour of these structural units defines the ”happenings of the world.” The claim is that to the extent that we can learn to use the ”same” organisational structure we are able to communicate effectively about such happenings. Accordingly the things of the world cannot be ”pre-given” as inherent in the world but are rather an organisational construction of things learnt by each observing human mind.

To some extent, of course, some of these units are ”pre-given” to us as given by the biological outfit of the brain and to some extent we learn the application of consensual organisation, but the human brain is at the centre of this activity – not an ontological world. The brain is directed to take what is eventually ”pre-given” in stimuli to build a useful worldview – but we cannot feature these stimuli nor decide upon them with certainty. In the case where human perception worked in a manner similar to a camera’s stiff lenses such reconstruction could have been possible. However a feedback connected brain favours adaptation, which make such reconstruction impossible and in that light we cannot uphold either the realist’s model of perception or the idea of a common ”pre-given” world of knowledge. When the realist’s model of perception now collapses and the realist’s doctrine also disappears as does and what remains in this situation is to formulate an alternate memorandum in terms of an ”allusionist” or ”constructivist” doctrine that utilises the only remaining consistent approach - the subject-oriented one.

We have been taught to regard perception as a process of transformation; mathematically speaking we map the ”real” object into an “image.” Our scientific training and the Newtonian world-view that without doubt has been the deep inspiration for the prevailing the realist’s worldview heavily reinforces this point of view. The SOA abandons the ”natural” but confusing idea that our mental impressions are the miniature “copies” of a pre-given world. Here the mental phenomenon - the token - is the “original”, and these mental tokens are the only useful objects of a mature science. The crucial point however is, that the realist’s model of perception seems so obvious and self-evident that we think that we have no other choice than to state that
the “original” and “outside” thing come first and that the mind impression is the derivative and thus we assume that the original is epistemologically pre-given. This is premature and misleading - and deeply buried in the Newtonian paradigm and for this reason we need a change of paradigm.

When we, on the other hand, consider the mental token to be the given “original,” - as in phenomenology - a totally new situation appears. **In this case we also have a choice whether to believe or not that the world “out there” can be the subject of human knowledge.** In due time we will understand that the belief in mind-external knowledge is an idea not only hard to defend – but as a matter of fact both misleading and unscientific – and thus we can readily connect to the ideas introduced by Bohr’s famous Copenhagen interpretation. This situation we can easily capture in the slogan: **Knowledge rises in a private mind only.**

Nevertheless here is buried one of the greatest difficulties in the acceptance of the SOA; **the realisation that the features of the emergent mental impressions (the tokens) occurring to the reflecting mind is the only objects of a mature scientific discourse.** The eventual association to other entities tracked down as "belonging to reality" is nothing other than private and social epistemological conventions, the essence of which have no certain ontological significance whatsoever. This is of course the very reason why Husserl hastily brackets the [reality] question. Can we just force the above-mentioned difficulties - the acceptance of the SOA will come easily. However scientific realism, in its classical interpretation, seems hopelessly forlorn and there is an urgent need of a constructive systems science in order to improve the foundational basis of science.
Part 2

2.1 Survey of Collected Papers

2.2 Conclusions and Future Research

2.3 Collected Papers

1. An Intuitive Approach to Modelling and Simulation
   manuscript 1992

2. Does Networking Replace Systems Thinking - or Is It Just Another Facet of Complexity?
   at the NUTEK-conference on Complexity, Sigtuna 1994.

3. Priverse - the All-embracing Private Consciousness.
   at the Xth Congress of Cybernetics and Systems, Bucharest – Aug. 1996.

4. From Descriptivism to Constructivism - a Challenge to Symbolic Modeling.
   at MMA-98 the Third Int. Conf. on Mathematical Modeling and Analysis, Riga 8-9 Oct. 1998.

5. The Subject-Oriented Approach to Science and the Role of Consciousness
   at the 1st Int. Conf. on Sociocybernetics 1999 in Colimbari, Crete, 25-31 May.
   http://www.unizar.es/sociocybernetics/crete.html

6. Sociocybernetics – the Path to a Science of Becoming?
   at the 3rd Int. Conf. on Sociocybernetics in Leon, Mexico. June 2001
   http://www.unizar.es/sociocybernetics/leon.html
2.1 **Survey of Papers.**

This section starts with a brief summary of the papers comprising part 2 of this thesis that are as wholes presented in the last section 2.3. The summary section is divided into two parts:

- 2.1.1 Modelling and simulation in its classical sense - (paper 1-2)
- 2.1.2 Questioning the Newtonian paradigm - (paper 3-6)

The aim of the collected papers is to bring about a gradual change that finally makes clear at an intuitive level but supported by formal arguments, the inadequacy of the prevailing realist’s doctrine. This insight is crucial and necessary to pave the way for the next step towards a radical reorientation of the classical way of scientific thinking, which means the abandonment of the object-oriented approach to knowledge (OOA) – the base of Newtonian paradigm - and its supportive realist’s doctrine. Its proposed successor is a paradigm adopting the stance suggested taken by the Subject-oriented Approach to Knowledge (SOA), which in analogy is said to be supported by the constructivist’s doctrine.

As few people are readily willing to abandon a familiar way of thinking and a well established framework such as the Newtonian paradigm, this thesis is not a systematic presentation of the SOA, but rather a presentation of a collection of papers dealing with the principles of modelling and simulation, and the problems encountered due to the classical paradigm’s negligence of the observer. This negligence has resulted in an insufficient understanding of the modelling process as such – no matter whether we discuss scientific, enterprise or the endeavour of everyday modelling. Unfortunately this lack of understanding penetrates all the paradigms of sciences – and therefore all scientific activity. To bring about a stepwise understanding regarding why a new paradigm is necessary, the papers collected in this thesis are intended to mirror how the ideas of the SOA have developed throughout the years. Thus there is a span from some early papers presented in a situation of pronounced uneasiness and deep conceptual confusion in the early 1990’s - paper 1 and 2 – through to the point where the need for a new a scientific paradigm finally, unavoidably, emerged. I hope in this way to be able to bring about a gradual understanding about why and how the Newtonian paradigm fails and is, at present, the very hindrance for a science of becoming – based on the proposed SOA.

Since this new approach means a radical re-orientation of the classical way of thinking, I will also discuss the subject-oriented way of thinking by pointing out several central issues and ideas touched upon, almost by accident, at the time of publication – but nevertheless which have later proved to be central points in the understanding of the SOA. The review below will thus concentrate on the central issues that in a sense connect the different papers to a conceptual whole supporting the SOA.

### 2.1.1 Modelling and Simulation in its Classical Sense

**P1. An Intuitive Approach to Modelling and Simulation**
- Manuscript 1992

This approach is an attempt to lay down the fundamentals of traditional modelling while at the same time trying to avoid the intricacies of mathematics. Here we emphasise the crucial role of the system observer – and do so using an imagery that is directly and intuitively appealing for ease of access by, for example, the social science community. This 2-step approach of meta-modelling also turns out to be very useful when explaining the process of modelling to natural scientists and mathematicians – who previously had very rarely included the observer in their modelling endeavours. The cybernetics community calls this meta-approach a process of "2nd order observation."
By including the observer in the enterprise of modelling we can already observe, in this paper (page 5), the emerging difficulties met with when using the traditional approach that regards the “real system” to be something pre-given and well-understood by any individual observer – as if there is only one completely correct way in which the God can be divided up into objects, properties and relations. From the computer scientist’s view it seemed that the system under consideration was very far from pre-given – it seemed, on the contrary, that in the context of information systems the interests and the goals of the observer had a great influence on the way he/she structured the world and his/her particular system view. Given this evident situation we asked: “Which system is the real one?” By what right does a physicist claim the view based on physical closeness (locality) to be the correct one to use – and on what grounds is this view considered “objective”? To us it seemed that the “things of the real world” were very much products of our imaginations, interests and goals – and in this situation rather the “projective illusion” proposed in this paper could perhaps contribute to the description of the overall system view made by the observer. The proposed 2-step model of modelling suggested a perceptual step (the perceptual path) followed by a presentational step (the modelling path) that involved a critical transitions between the two different domains of human conceptualisation /real world → mental model → real model/ that had hitherto been buried in the traditional “mapping” view of scientific modelling. The observer-dependency of observation (in the perceptual step) seemed to be a crucial question that science had hitherto, with few exceptions, refused to address in a satisfactory way.

Another problem of “scientific objectivity” lies in the presentational step with its presumed “objective” end product. In computer science the systems view was, on a regular basis, explicated using several different modelling frameworks – such as mathematics, logics or some other conceptual framework. This involved not speaking about the use of different programming languages to implement the models – and we have been long since aware of the limitations of their respective expressive power and the effects of these limitations. For science to be “objective”, it had in one sense come to mean that scientific description, by means of some hidden methodological artifices, was able to be shared by scientists and in that sense also very close to some “truth” — or that at least scientific truth was more certain than some everyday verbal explication. The traditional naïve mapping model of perception – clearly suggests a “real” source domain and a “real” model domain – and a homomorphic mapping, where one object leads to one model – the “objective” model of science. Employing the technique of multifaceted modelling one was forced to ask: Which description was the one to consider “objective” — and on what grounds could such a choice be made? The fate of logical positivism clearly shows that we cannot simply specify one particular framework and hope to reach “objectivity” in that way. Possibly we could attain a consensual description in that way but never “objectivity” of description — because “objectivity” is supposed to mean that all trained scientific observers will produce like descriptions or produce like predictions and here “like” means “objective.”

In information system analysis the descriptive tools are chosen on grounds of affability – and not chosen to provide some “objectivity” of description. H. Putnam (1981) provided a devastating critique of scientific objectivism realism in that respect according to Lakoff (1987) who formulates the inconsistencies of the traditional model-theoretic semantic views by compiling the view of Putnam:

In summary, Putnam has shown that existing formal versions of objectivist epistemology are inconsistent: there can be no objectively correct description of reality from a God’s eye point of view. This does not, of course, mean that there is no objective reality - only that we have no privileged access to it from an external viewpoint. (Lakoff 1987 p.259)

So what Putnam describes is the “describer’s dilemma”: Given a thing of the world – how do I describe this thing in a way that can be understood by other scientists? Well - the most readily available idea was to produce a description close to the truth – and since, intuitively, there could only
be one truth, this truthful description must be the aimed at “objective” one. In that vein the objectivist’s problem is what model to chose when describing the world “objectively” – and this is what makes Lakoff state that scientific objectivism is impossible from the externalist perspective: God’s Eyes point of view cannot be accessed by any human being.

There is no God’s Eye point of view that we can know or usefully imagine; there are only various points of view of actual persons reflecting various interests and purposes that their descriptions and theories subserve (Putnam 1981 p.50)

He and Putnam thus suggest that the world as we understand it, is in different situations structured by which conceptual schemata we use in this conceptualisation. The use of the God’s eye view or the externalist view is bewildering because nobody has access to such a view. However, even if we had access to this view – it would be of little use because the individual observer structures the world according to the problem he has to solve, and not for the sake of finding God’s view. Putnam argues that what we need is the internalist perspective – thereby putting the clock back to the time of Mach’s phenomenalism by claiming that the sources of our models are not the “things of world” but rather the phenomena of mind.

'Objects' do not exist independently of conceptual schemes. We cut up the world into objects when we introduce one or another scheme of description. Since objects and the signs are alike internal to the scheme of description, it is possible to say what matches what (Putnam 1981 p.52)

The internalist perspective does not solve the problem, however, since, in the first instance, the use of the internalist perspective also produces a multitude of models. This situation is in fact very easy to grasp since we, as human beings, have always been internalists – we really have no other option - we only fool ourselves sometimes by believing we are Gods – by using the Newtonian paradigm for instance. However Putnam and Lakoff point out an important restriction to human conceptualisation – all our models are theory laden, i.e., the understanding of the reality we live in is structured by the conceptual schemata we use for this very description. These schemata are given by the modelling framework (language) we use in the production of these models and for that reason it seems that perfect “objective” description is impossible – and only an approximate possibility.

Secondly if scientific objectivism claims that there is one completely correct way in which reality can be described, then it must also claim that there is one absolutely correct way in which reality can be divided up into objects, properties and relations, and thus, as a consequence, the existence of a God’s Eyes view must be accessible to scientists. This is a senseless claim and what is left in this situation is to claim that the mental model arrived at is “objective”, i.e., that “objective” perception is possible. Taking scientific realism for granted this amounts to saying that human perception is observer-independent – or at least that a scientific observer can learn such perception. Paper no 5 will show this task is in principle impossible – and we also, through the above discussion, understand that the perceptual path is the weak link of the “objectivist’s” line of argumentation.

This paper also tries, quite unsuccessfully, to introduce the use of an optical filtering analogy to explain the diverse factors influencing scientific modelling. Of course this analogy was very much inspired by the ideas of Kuhn (1962).

On the other hand, this paper is rather successful in resolving the rather involved set of successive steps needed to fulfil practical modelling projects from the phase of system identification through to the final product of a working set of models for practical use. This is particularly true in section 8 – entitled “The intuitive approach - some illustrative examples” where this 2-step meta-model of modelling provides the very basics of human conceptualisation and draws out some very important aspects thereof - and also at present has remained essentially unknown. Since the classical idea of a pre-given “reality” fails here, this insight provided the personal starting point for a quest for a more reliable base of human knowledge.

SIMULA – the first dedicated simulation programming language – which has also inspired B. Stroustrup1 in the development of the object-oriented C++ had a strong influence on computer modelling and simulation at the beginning of the 1990’s and the connections between object-oriented

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1 http://www.research.att.com/~bs/homepage.html
programming, the object-oriented way of thinking and simulation analysis were developed in this paper.

P2. Does Networking Replace Systems Thinking - or It Is Just Another Facet of Complexity?
-at the NUTEK-conference on complexity, Sigtuna 1994.

Networking – and the network concept were in vogue during that time – due to the interest in structural complexity arising from the modern ideas of chaos theory (Gleick,1987) and the renewed interest in communication - communication networks and Internet in particular. One purpose of this paper was to establish that the network idea does not introduce anything new, it is just another word for the well-known term of system - at most reflecting another point of view of a system.

Another more important purpose of this paper was to show how vain attempts at simulation or modelling are in disciplines that lack a paradigm or suffer from conceptual confusion. The Swedish network tradition in industrial business marketing (SNA) was here taken as an example of a useful substitute for mathematical modelling in situations where the complexity of the UoD was growing. The new problems dealing with huge networks and complex systems called for computer experimentation and simulation. The simulation methodologies are based on conceptual programming languages – some of them easy to learn and easy to use - but this technique however requires some familiarity with data structures and for that reason this paper discusses some aspects of the modelling of networks – in particular SNA - from the perspective of computer science.

The ideas of SNA exhibited the use of a multi-faceted conceptual vocabulary, however, which severely hampered the modelling efforts. The frequent use of ill-defined concepts and invented buzzwords in an effort to try to explain the ideas involved proved to be very unsatisfactory and confusing – but nevertheless not necessarily a sign of a lack of consistency or weak foundations. This situation often occurs when researchers, lacking suitable concepts and language in their own discipline try to explicate novel ideas.

This situation points out a serious problem: The lack of a conceptual model as a basis for discussing the UoD is not only the reason for disciplinary difficulties - but it does create an interdisciplinary confusion which can sometimes have a paralysing effect. This embarrassing situation has been discussed at length elsewhere. Much of the social sciences lack a paradigm, which unfortunately brings them into disrepute. However SNA does not lack an implicit paradigm – but this paradigm must be brought out into the open (made explicit) to become shared knowledge for the sake of both disciplinary and interdisciplinary understanding. What distinguishes science from non-science, according to T. Kuhn (1962), is the existence of such an explicit paradigm. In the same vein we can readily spell out that rational and irrational human activity is separated on a similar ground.

The third purpose of this paper is to explain to the community of physics that an entirely new situation emerges in business marketing, for instance, when one has to deal with “fields of interaction” that are generated by the “ideas of the subject involved” rather than some homogeneous and uniform physical force fields as defined by some pre-given laws of nature. This insight, to me, becomes the basis for understanding that the Newtonian paradigm as defined by physicists has an area of application that is only valid in physics - and is not valid in the case where “object-internal” processes are to be taken into consideration.

2.1.2 QUESTIONING THE NEWTONIAN PARADIGM

The lack of use of disciplinary paradigms makes the projects involved in modelling information systems very difficult to handle – and mainly relies on methods that are ad hoc – and moreover since such projects are usually cross-disciplinary the confusion and misunderstandings sometimes become extremely unwieldy. Bearing this in mind we find the situation - at least in the natural sciences – somewhat different. Without doubt most social sciences lack explicit paradigms – but in the natural sciences the use of the term paradigm (or scientific theory that is the term preferred among natural scientists) is widely used. Popper even once introduced the term “theory laden” to specify that in science the world is viewed through the glasses of some particular theory or theoretical framework.
For that reason we speak about the theories of relativity, quantum theory and even the Newtonian paradigm and so on – and in that way make reference to a set of assumptions that we uphold about the UoD. This kind of discussion is delusory however, as the very moment we ask what these assumptions are, most people are at a loss for words. This is exactly what Kuhn (1962) points out: “We have no direct access to what it is we know, no rules or generalizations with which to express this knowledge.” What Kuhn means is that we are trained in a paradigm to the point that this paradigm has unconsciously become part of our thinking – and we are almost blind to its influence. He even takes one step further suggesting that there is even a cultural paradigm of being a human: “Surveying the rich experimental literature from which these examples are drawn makes one suspect that something like a paradigm is prerequisite to perception itself. What a man sees depends both upon what he looks at and also upon what his previous visual-conceptual experience has taught him to see.”

In that sense Cartesian dualism is particularly confusing: “What do we refer to when we speak about the world?” – and this is the crucial and deciding question in systems modelling. The omnipresent misinterpretation referred to as presented in section 1.1 made me suspect that something was seriously wrong with the classical point of view and accordingly the Newtonian paradigm.

The rest of the papers presented in this thesis are a reflection of this doubt and which thus become a firm conviction. The pattern in the papers to follow is much the same - the Newtonian paradigm (using the OOA) is attacked from different angles – and is always driven into a corner - ending up with the suggestion of making use of the only remaining approach – the SOA.

It all started in Bucharest.....

P3. **Priverse - the All-embracing Private Consciousness.**
- at the Xth Congress of Cybernetics and Systems, Bucharest – Aug. 1996

My interest in control theory and feedback brought me at an early stage to the cybernetics community with its prominent preference for interdisciplinary research. At the time of this paper the problems relating to the details of the 2-step modelling enterprise and the use of the previously mentioned “visual” filtering analogies were embarrassingly evident – and in combination with the difficulties met with in quantum physics, doubts about the presumed things of reality correctly being able to be seen as pre-given to the human observer began to appear. Since we all are perfectly able to model human fantasy and illusion – I began to doubt that the endeavours of science were based on plain discovery. The crucial question began to emerge: “What is the difference between the real and the illusory?” a question that should rightfully be answered by the science of the “real phenomena”, i.e., physics – but no clear definition was to found in its framework. On the contrary it seemed the real/unreal conception was, instead, continually adjusted to embrace new phenomena as physics evolved. This lack of scientific clarity seemed surprising and strange to me – and a reflection of the conceptual confusion is mentioned above.

The encounter with the cybernetics’ community also allowed acquaintance with a school of philosophy that is oriented towards the social sciences and humanities – a knowledge domain where the objects of interest most often are neither pre-given nor permanent. The parallels between the 2-step model of modelling and issues dealt with in Husserl’s pure phenomenology begun to be obvious.

In this paper the mind-frame is regarded as the “seat of mental impressions”, where the phenomena of human perception appear and as such in a sense very much disconnected from the “outside reality” as espoused by traditional science. I asked: Why do we tacitly assume perception to be a mapping procedure that directly connects to a pre-given thing of reality? Is it not true that the cognitive sciences have indicated that human perception is “theory-laden”? These questions had started to bother me and it seemed that to explain scientific modelling one first had to explain human conceptualisation, the latter requiring a solid understanding of human consciousness – that was still in its infancy.

Of even greater importance was the understanding that so defined the human mind-frame could not possibly be the target of scientific observations in its traditional sense. The primacy of subjectivity here prevents “objective” observation. The only person able to “observe” such a mind-frame is a human who has the mind-frame. Since the mind-frame here is the “object” of observation – one in a sense

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2 As Husserl does
could call such observations “objective.” However this is not at all the meaning we give to the term “objective” in this context – “objective” here rather means “non-subjective” - which is juxtaposed to unprejudiced observation. The question emerged: “Is the classical “objective” science useful for the task of explaining modelling, conceptualisation and human consciousness – or later is such an endeavour even possible as a science?”

The proposal here is a new interpretation of scientific modelling - the SOA that points out – modelling is the means to explicate the happenings of the mind-frame – which here in the beginning was juxtaposed to pure human consciousness. From that point of view the natural languages emerged as the most important modelling tools of mankind – and also for science.

The 2-step model of modelling enabled Cartesian dualism to emerge - with its matter/mind dichotomy and the ensuing inside/outside problems – based on the idea that we all possibly all live in disparate universes. This gave rise to the idea of a priverse as being a concept embracing my private knowledge. In this paper the mind-frame (and not the priverse) is juxtaposed to consciousness – an idea that I later deserted.

The idea of a well-defined reality (object) or some things (objects) belonging to it had in some ontological sense begun to fade – in consequence the classical OOA here is replaced by the SOA. Without going into details, it is important however to point out that this point of view is not identical to subjectivism or even to the subjectivist’s approach. However the inside/outside perspective is very important in this paper – at least the idea of regarding inside and outside to be domains that are ontologically separable - an attitude that is also not compatible with consistent monism and is later abandoned.

The inside/outside distinction (sect. 6) is mirrored by E. Mach’s inspired idea of sensations as being the primary basis of human knowledge: “That is, we admit that ‘the external events of universe’ are the casual precursors of our private sensations - which make up our priverse.”

In this paper the subject’s need to organize his/her mind-frames and to keep track of them is brought forth and such an order is established by a binary relationship between the mind-frame and the natural numbers thus defining the mind event (time-tagged sensation):

\[<\text{frame}, n > | n \in \mathbb{N}\]

the parameters of which are strictly personal. According to that view pieces of experience are organized into sequences – processes – where the order between the frames must be maintained in order to avoid information loss. To establish a local time order is thus crucial but we also notice that such a process model does very well without the previous definition of some physical space. This recognition comes almost as a shock to physicists brought up in the four-dimensional space-time of relativity – a conceptual world lacking of space (!) - but soon I recognized that I had just reiterated an early claim of Kant.

Internally this process of time-tagging is established by the use of a biological clock and the pace of this clock gives rise to the “feeling of time” – a feeling that could not possibly be defined as a sensation and was rather a reflection of the “inner” inertia of thinking – thinking takes time.

In a sense a living being is forced to administrate the flow of local time much earlier than objective time, which led me to believe objective time is only a social phenomenon. I noticed the order: feeling \(\rightarrow\) private conception \(\rightarrow\) social (objective) convention. The time’s arrow was connected to local time and human experience defining times reversal as plain fiction and a mathematical delusion.

Sect. 9 explains that the qualities exposed by the mind-frames “is to a great extent dependent on the receptor outfit of the cognitive system in question” and in that sense perception is very dependent on the individual observer and the idea of “objective” observation becomes a more and more unbelievable puzzle.

I was acquainted with the writings of Freud (1961) as a young student and his works gave me the solution to a difficult problem of phenomenology: “How come the world seems to be ‘out there’ – and not in my brain?” The simple reason was the “outward projection mechanism” which at first glance, however, seemed incredible. By doing experiments in dark rooms and with asymmetric glasses and contemplating the blind spot phenomenon I slowly made this idea workable and later found out that the psychologist M. Velmans (1990) had proposed the same “mechanism.” We were hopefully both on the right track.
Also the truth conception that is so central to human reason began to fade, an idea that led me back to cybernetics and the phenomenon of 2nd order observation. Heinz von Foerster\(^3\) and his followers here convincingly claimed the possibility of building human knowledge without reference to some reality in some ontological sense and I once more met with the feedback mechanism which had now emerged as the crucial phenomenon for understanding human cognition. Regarding the state of consensus we so easily attain - could it be that the human brain adapts towards a consensual understanding?

When studying Bunge (1977) who has been the handbook of the Newtonian paradigm – I found a couple of lines that abused the subjectivity of Basri (1968) – which gave me the clue – a consistent science is subject-oriented and takes off from private experience – just the way Descartes once did – but did not succeed in fully realizing.

The social approach to the problem of objectivity that is outlined at the end of the paper pointed towards Kuhn’s (1962) ideas of science as mainly a group activity. Evidently all these ideas were at that time too raw and bold to gain acceptance. I felt the need of stronger arguments – also for my own sake – and entered deeply into consciousness studies. I decided to try the approach of symbolic modelling.

P4. From Descriptivism to Constructivism - a Challenge to Symbolic Modelling.

This paper starts by considering the ideas of scientific realism with its presumed objectivity where the pre-given features of reality are “discovered” by the observing scientist and specified in the form of a set of statements that – after processes of consensual approval – turn into facts. Such “facts are exchangeable experiences that can be made into shareable knowledge.” The use of the term “objective” knowledge in this situation seemed bewildering since such knowledge historically means “knowledge collected by the non-subjective observer,” i.e., the detached scientific observer. So to be “objective” is to stand in a detached relation to the object of observation\(^4\). The term “shareable” rather give associations to the conception of “consensual knowledge” and from this viewpoint it is suggested that a set of facts is compiled into a model that is consensually approved – which hereafter becomes part of the disciplinary paradigm which in turn will influence the scientists world view.

The realist’s approach to modelling – called descriptivism – and the mathematical ideas behind it are explained and thereafter the realist’s worldview – the OOA - is scrutinised. Computer scientists often make use of a similar view during systems modelling, however here the objects of observation are neither so self-evident nor so well defined as compared to the situation met with in physics for instance. The boundary was now unclear - the observer’s influence on its object of observation cannot be disregarded any more – not even in systems modelling - and further the principal limitations of scientific observation as stated by Heisenberg must be taken into account.

The state space approach claims the objects are "known" to us only through their properties and properties are often represented in terms of attributes - a known property must have at least one attribute representing it. Descriptivism claims that the state space approach is the appropriate one to use as complete specification formalism for the mathematical modelling of the elements of an independent physical reality. This formalism is the firm mathematical foundation (modelling paradigm) of the mechanical Newtonian paradigm – as such completely causal and deterministic.

The state space approach is criticised for not taking the observer into account, for the groundless assumption that the process of observation can be captured by mathematical mapping, and for leaving the modelling formalisms used totally outside the realm of human conceptualisation. The last issue is further expanded under the heading “the modelling of ideas”, and here we also claim the spoken natural language is a plain model for the purpose of both inter-subjective and auto-communication. The seldom-recognized situation that scientific knowledge exchanges normally come about by means of multifaceted modelling is touched upon and tacit communication is also considered as a promising research field.

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\(^3\) See Segal 2001.

\(^4\) The ideal of the natural sciences as prescribed by Galileo and Newton
“What is reality” is the next question addressed and the risk of confusion between the I-reality and the “real” reality – the presumed “out-there-ness” is mentioned. We establish that the I-reality – this very personal and private impression is the only sign we as living beings have of the presumed “out-there-ness” and then we understand that pre-given-ness of the “out-there-ness” is barely a hypothesis that is buried deep in the Newtonian paradigm. We also find out that scientific measurements are principally nothing other than plain human observation. The superiority of measurement has to do with the quality of the observations – and must not be confused with some principal superiority – often incorrectly maintained.

In this paper the idea of human observation as a process of decision is beginning to emerge, which gives more substance to the mechanism of “outward projection.” The idea that the “meaning of a message” emerges only in a private human mind also begins to form: “bits of information or messages are ‘stuff’ that are born inside a living consciousness – and die outside it. No meaning (or substance) can be attributed to such raw data outside a knowing consciousness5 – and all of a sudden the confusing classical dualistic view of the world disappears. There is no need for two worlds – one outside and the other inside – the “on-side world” is all there is and the on-side world is anchored in my mind/consciousness - my private construction – my priverse. The perplexing ideas of constructive brains and how the brain handles the “blind spot of the eye” all of a sudden appear clear - the dual pair world collapses into a holistic point of view – no outside and no inside – my mind-frames are all there is.

We find the “out-there-ness” is the equivalence of the “black box” concept of control theory and this view is pure instrumentalism. Human percepts comprise nothing other than the very instrument panel of living and such a panel must neither be true nor even common to all living beings – just useful to each one of us.

The outward projection mechanism proposed here for the first time opens the door for an unexpected reversal of conceptual causality: “the I-reality (image) is the cause of the knower’s search for "clues from outside." Such an outside clue (when found) is the cause of a cognitive confirmation of an object. Any object definition is then due to a “circular process of mutual causal reinforcement” and in this way both the concept and the sense of a physical space is created. This space is populated in the mind by the colourful images of I-reality thereby producing a vivid and colourful reality – the human mind creates its reality on its own!

From this point of view both truth and ontology vanish – but the claim is its wake is that we can, for the first time, create a “non-subjective” science – i.e., a consensual science – that is not based on a misconception, i.e., does not its stance from the doubtful hypothesis of a pre-given world.

P5. The Subject-Oriented Approach to Science and the Role of Consciousness

-at the 1st Int. Conf. on Sociocybernetics in Kolimbari, Crete, 25-31 May, 1999.

Three years have now passed since the SOA was presented for the first time – and in spite of the fact these ideas “present some evidence suggesting that the prevailing paradigm of classical science is partly a misunderstanding” they seem to have passed unnoticed. It seemed to me that the realist scientist in spite of the findings of quantum physics and the later clues provided by 2nd order cybernetics simply refused to reconsider the instructed traditional point of view, i.e., the Newtonian paradigm. I was in a good company (von Glasersfeld, 1988). Despite the precarious situation for consciousness studies, loyalty to the classical paradigm appeared to be an obstacle even to attempts at understanding the new approaches. Many scientists do not even seem aware of the paradigm that controls their activities – and many are not even familiar with its basic concepts and Kuhn (1962) had asked that attention be drawn to this problem.

For obvious reasons I felt the primacy of subjectivity needed some clarification – or at least its very consequences.

This paper points out that science has two options to keep up “objectivity” in this situation:

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5 My distinction between consciousness and mind was very floating at that time
6 The off-side world is the world we know nothing about
• To postulate the validity of some sort of perceptual similarity, i.e., that observation is
independent of the individual perceiver. This is the path advocated by scientific realism.
• To admit the primacy of subjectivity, i.e., to accept the troublesome situation and to try and
adjust the scientific reasoning accordingly.

which is the path advocated by the SOA and in doing so there is strong support offered from:

• The theory of quantum physics, which according to most interpretations, is rendered
incompatible with the realist's postulate.
• The modern cognitive sciences that most insistently claim that the process of perception is
theory-laden

In this situation it is very difficult to defend scientific realism since among the realist's postulates
we find the tacit classical assumptions:

• Observation and experiments disclose some unknown but pre-existing reality
• The things of reality possess certain states and properties that are observer-independent

and in this paper we claim that the two mentioned postulates are both misleading and perfectly
unnecessary.

My claim is that the primacy of perception and the considerations presented in the foregoing
sections have shown that the classical idea of an observer-independent unary world is now very
difficult to defend. The principal reason for that is the feedback of knowledge - see figure 5.

The SOA claims the “objects” of perception must be constructed outgoing from the privately
experienced state changes in consciousness. The "out-there-ness", must be considered to be nothing
more than a pure model theoretic conception — which cannot even be exposed to questions about
truthfulness or falsity.

These are the fact presented:

1 When tackling the process of observation we cannot use the OOA unless we at the same time
adopt the realist's postulate. This is an inescapable consequence of the primacy of subjectivity.
2 Both quantum mechanics and modern cognitive science clearly indicate that the realist's
postulate is unlikely and probably incompatible with their findings.
3 Finally the model theoretical considerations undertaken in this paper will cause serious
misgivings for the whole of science – and do so without reference to either quantum
mechanics or the cognitive sciences.

So what we have actually called into question is the imperative necessity of the realist's postulate. The
surprising answer is that this postulate is not only unfounded - but also unnecessary. Even more
surprisingly - we can rescue science by its very removal. We should here expect a change of
paradigm – a change that would for instance legitimise consciousness studies as a genuine science.

Part B is concerned with an explication of the SOA where we first establish, surprisingly enough, that
the SOA with its very private point of departure will pave the way for a genuine definition of an inter-
private (objective) universe – a consensual universe of science.

As a matter of fact a whole epistemology has already been erected on this basis — called
phenomenalism and according to this view the mind-entity (and its associated percept) is primary and
the only source of knowledge. Based on this view human consciousness itself constructs (or creates)
the features of the objects of perception – a view called constructivism.

The details of the SOA are dealt with in a later presentation – so we instead focus on what happens to
the lost “objectivity” of science – because this idea can no longer be upheld up in the classical view.
To our great surprise we find that it is now possible for the individual to produce a model of his/her priverse using a description that does not contain any explicit elements related to his/her own consciousness. The living individual proposes a symbolic conceptual model and discovers that he/she can communicate by means of it – and this model is, in coexistence and cooperation, further developed into a good communication tool – the successful use of language and scientific practice proves the usefulness of this thesis. The individual brains are “tuned” to unanimity in this way and when describing our priverse accordingly, my priverse becomes the legal subject of a consistent and complete description — in spite of the limitations accounted for in section 6.

In this way every mind can produce external models of the subjective entities embraced by it and such descriptions do not contain any elements that can be derived from it. This is an important achievement since we have now attained our goal – an observer-independent description of a priverse and its conceived entities. The external observer-independent models as described above are the communicable and suitable objects of an inter-private comparison process.

This is a great achievement since we now have available a set of observer-independent models to define our abstract consensual scientific universe. Still these c-models implicitly programmed by individual neural networks have a very private touch – private to the individual or the group. However in the formal description of the c-models there is no reference to any individual consciousness – and therefore we can all use these c-models by virtue of the discovery of the internal mind adjustment process.

Now it is possible to envision Science (or any branch thereof) as a fictitious "collective mind" (CM) in which a special model universe is embedded — a consensual universe of discourse or the common consensuality of mankind. What are fed back by the fictitious feedback loop of the CM are the theories of science and the internal models of this CM have very appealing features since they all lack explicit reference to both CM and any other mind. Also the well-known and perplexing Lorentz Fitzgerald contraction receives a more plausible interpretation in this framework since the “length at rest” is the only length we can speak of – any assigned length in motion, i.e., outside the observer’s frame of reference is a pure allusion as is the eventual measured time dilation.

What type of construction is it, this grand structure of science that remains intact even if you change the basic assumptions? The conclusion we draw from this is that a sound scientific methodology has produced good results in spite of human misunderstandings. The real support for any scientific theory ultimately comes from experience: from experimentation in the laboratories and from observations of phenomena in the presumed nature (our model universe) and its validity has been reinforced by learning, close cooperation and consensual understanding.

The laws of nature do not change because we compile them into the laws of the mind – but we have begun to understand that the human mind influences the happenings of life much more than the clues from outside do. Here we encounter the human agent who sets up the experiments and defines the relationships between the observer and the observed happening. The description of the happening will change slightly, the explanation considerably – but the happening will remain essentially unaltered. The experimental methodology that was so very helpful in developing classical science remains intact and is still in full force - the useful method sieving out loose (and therefore subjective) speculations from the discourse of science still remains the consensual ideal. However human feelings and intuition are no longer banned – which benefits the non-physical sciences.

P6. Sociocybernetics – the Path to a Science of Becoming?
- at the 3rd Int. Conf. on Sociocybernetics in Léon, Mexico, June 2001.

To a computer scientist it is very obvious that observation and modelling are activities driven mainly by human decisions and from that point of view it seemed strange that the Newtonian paradigm had so effectively banned human feelings and intuition. The decision as to whether a colour is green or yellow asks for a decision procedure and the idea that such a decision can be made “objectively” by any being seems strange. The very moment one realizes that such a “decision” made by a spectrometer does indeed merely refer to the decision of the engineer who constructed the instrument regarding the green-ness, this feeling of strangeness is reinforced. How does his idea relate to the eventual truth and how is it possible to claim the “objectivity” of science just by prescribing “outside” observation? The great scientists were free to use both feelings and intuition in their deeds.
My occupation with the SOA had also made me wonder: Why is truth such a central concept to both human culture and science? In spite of this position of centrality for instance the truth as referred to by physics was adjusted quite frequently. Damasio (1994) had similar ideas and referring to the tragic fate of Phineas P. Gage he convincingly argued for the importance of human emotion and feelings in the struggle for survival. It appeared to me that this crucial decision instrument was expelled from science – at least natural science – during the scientific revolution.

Even earlier, my time together with sociologists had convinced me that human feelings were essential – as a matter of fact the most important instrument - in human decision making. This idea does not tally with the idea of human rationality however, but a long life of experience had convinced me that this idea was mostly idle imagining. The SOA does not expel human feelings and intuition and since the ideas of the cyberneticians had also been central in this development – the idea to merge them into a proposal for a paradigm of sociocybernetics was imminent. Sociocybernetics was taken as the exemplar for the new science of becoming where the traditional Newtonian paradigm was succeeded by the SOA and in this framework there was also a place for the science of consciousness. This was the central idea of this paper, written to celebrate a jubilee at Léon in Mexico and here we claim that science is at the edge of a new époque where human feelings ask for recognition and the classical TPP for several reasons seems out-dated.

The classical idea of scientific “objectivity” did not fit into the picture after the cyberneticians’ discovery of the knowledge feedback that takes place in the human brain. In doing so they were simply accused of performing non-science. Since I had been working with the SOA for many years and had already formed the personal opinion that the cyberneticians and some progressive physicists such as Schroedinger, Bohr, Wigner and Bohm were the only ones actually performing science – because they dared to look at the very paradigm of science, I felt the need to once more express these ideas – and back them up by a retrospect in a philosophical perspective.

By the end of this journey I was deeply convinced that the Newtonian paradigm with its TPP was outdated and the sooner we could abandon it the better. To me the consciousness puzzle stopped being a puzzle many years ago – however I have not yet been able to convince anyone except a journalist in a local newspaper about that. Now I also felt I could explain why this was so – I decided to try again but being almost convinced that my ideas would fall on deaf ears. However I am not alone in this situation and therefore I will as the preamble to the paper borrow the words of another champion of constructivism – Ernst von Glasersfeld (1995):

There is, of course, the danger of being misunderstood. In the case of constructivism, there is the additional risk that it will be discarded at first sight because, like skepticism -- with which it has a certain amount in common -- it might seem too cool and critical, or simply incompatible with ordinary common sense. The proponents of an idea, as a rule, explain its non-acceptance differently than do the critics and opponents. Being myself much involved, it seems to me that the resistance met ... is not so much due to inconsistencies or gaps in the argumentation, as to the justifiable suspicion that constructivism intends to undermine too large a part of the traditional view of the world. Indeed, one need not enter very far into constructivist thought to realize that it inevitably leads to the contention that man -- and man alone -- is responsible for his thinking, his knowledge and, therefore, also for what he does. Today, when behaviorists are still intent on pushing all responsibility into the environment, and sociobiologists are trying to place much of it into genes, a doctrine may well seem uncomfortable if it suggests that we have no one but ourselves to thank for the world in which we appear to be living. That is precisely what constructivism intends to say -- but it says a good deal more. We build that world for the most part unawares, simply because we do not know how we do it. That ignorance is quite unnecessary. Radical constructivism maintains -- not unlike Kant in his Critique -- that the operations by means of which we assemble our experiential world can be explored, and that an awareness of this operating (which Ceccato in Italian so nicely called consapevolezza operativa) can help us do it differently and, perhaps, better. (Glasersfeld 1981)
2.2 CONCLUSIONS AND FUTURE RESEARCH

In the Newtonian paradigm, science is believed to be “objective” - that is to say the description of our knowledge about the presumed unary pre-given Nature is believed to be independent of both human observation and the process of description. This thesis shows that neither observation nor description in this manner is possible.

When it comes to presentation the choice of axioms (among other factors) decides the properties of the language (modelling framework) used and thus also the form of the model expressions. We cannot give “objective” preference to any of those modelling frameworks – which is exactly what Putnam meant by saying that “there is no God’s Eyes view.” The communicational outputs of scientific observation (the model expressions) must be based mainly on convention – a strategy called instrumentalism. In conclusion the view of a consensual scientific community is a pure agreement and here we find the fundamental and often overlooked question regarding the way such scientific consensus is to be achieved. There is no such consensual understanding spreading over all academic disciplines – which means cross-disciplinary approaches are hard if not to say impossible. This thesis also shows that a science built from the detached observer’s position is in principle insufficient – instead claiming that we can come to the rescue of science by using the SOA. In this framework the misguided idea of knowledge “contained” in a pre-given ontological reality vanishes – in favour of the idea of a consensual set of models, some of which also give a commonsense meaning to familiar model expressions. Contrary to classical science the “question posed” here seems to be the factor that decides what modelling framework are to be used – rather than truthfulness to some pre-given reality. This means a shift from objective to “instrumental” science, to a framework in which modelling - the instrument of presentation - becomes an integral part of scientific theories. The new paradigm implies that modelling – understanding of the process of presentation - has to be included explicitly in the scientific description of phenomena.

When we then turn to observation we can observe a similar tendency and this recognition entered science with Heisenberg saying: "What we observe is not Nature itself, but Nature exposed to our method of questioning.” This means a shift from objective to "epistemic" science, to a framework in which epistemology - the method of knowing – also becomes an integral part of scientific theories. In the SOA we take yet another step in this “abstract” direction by the assertion that the object of science is neither Nature – in the form of something real or substantial - nor anything else apart from our ideas: What we expose to questions and present as the fundamentals of science is the “content” of our private consciousness (the working of our minds) and the way it has evolved in close communication and coexistence with other living beings.

We contradict Heisenberg by removing all ontological traits from Nature - reducing it to barely a name domain of knowledge, i.e., part of epistemology. This thesis advances the idea that the “world” that surrounds the living being is most of all an allusion – a private construct created by outward projections of the experienced sensation complexes of our mind. This set of allusions – the priverse – is personal, individual and inaccessible to another living beings. For that reason we are directed to the use of different models as a mean of communication.

These impressions are the private objects of thinking and the basis of the consensual objects of discussion for science but we nevertheless admit the two faces of the real conception. For the intellectual activity of science it makes little or no difference when we consider all human impressions to be abstract (unreal). This is to say that science benefits very little from the real/unreal distinction – and this is of course the main reason that science has managed to manage for so long without a clear definition in this matter. To the living being, on the other hand, the correct decision regarding what is real has always been of crucial importance for the individual’s survival. The wise man runs when he sees a real tiger – and will find it useful to shake off the hallucination and the correct decision as to whether an impression is a true percept in its classical sense or a hallucination could mean the difference between his survival and death. For this reason the repertoire of human observation has always included actions supportive of such a decision. The Stone Age man used the sense of touch with its accompanying “feeling of extension” to separate real objects and hallucinations. This is why man splits the world into the “outside” real world and another “inside” image-like world of impressions (mind images). This dualistic worldview is mostly the result of human physiology and the cultural habit to blame Descartes for this distinction seems totally out of place.
Descartes’ establishment of the two domains *res extensa* and *res cogitans* was nothing other than the confirmation of this human legacy – which also unfortunately posed a severe setback to the subject-oriented conceptual framework he had himself proposed. Several decades later Berkeley gave a more useful immaterialist reformulation that has however over time been sadly misunderstood. Things that were able to produce sensuous feelings (perceptible) to a human being were considered “real.” For obvious reasons most real things are “outside” the perceivers’ own body – for that reason “pain” in a sense was classified as being “unreal” or at least non-physical. For the same reason the “burning” light of the sun was the reason for the light’s classification of real – and this was generalised into the proclamation of the reality of the electromagnetic wave. It seemed that physics simply adjusted the real conception to fit its own discoveries – and after all this inclination remains since the Nobel prizes were awarded for the discoveries of the electron, the neutron, the pi-meson and so on - and not for the proposals of some new models to explain the observations made in the physicist’s laboratory.

2.2.1 The solution to the realist/anti-realist controversy.

In spite of claims to the contrary we have shown that the realist/anti-realist controversy to be decided at the methodological level of science – the very moment we leave the Newtonian paradigm of thinking. The dualist model of human perception became the nucleus of the new scientific worldview erected by Galileo, Descartes and Newton in which the detached observer became the ideal of scientific observation and the mind of clarity. This dualist model took hold in the “outside real” world to provide the objects of scientific discourse and the process of observation as the means of discovering this Nature. However the presumed reality or outside-ness of Nature was not the main issue here. What the realist’s looked for was the “norm” of scientific observation – a norm that could provide the basis for a truth decision. In that sense the real and outside world became the “pre-given” – a normative Nature given prior to man – or at least man’s knowledge of this Nature. A pre-given Nature is a useful norm for truth decisions that also guarantees the singleness of Nature. Kant protested, claiming “the thing-in-itself to be unknowable” and accordingly also the “outside” world – but in vain. Science took over and most scientists are true to the Newtonian paradigm – and here the detached observer is the scientific observer. Physics and mathematics came to develop the natural sciences and the ideal of scientific objectivity – sciences that had neither place for human feelings nor consciousness. The exclusion of the human feelings was thought to guarantee the “transparency” of human perception (the observer-independency of perception) that together with the idea of a unary pre-given world prolonged the naïve idea that we are all in principle “looking at the same world.” The idea was that could we just learn to suppress our in-born subjectivity the “pure objective thing” would reveal itself before the eyes – and this type of revelation was reserved for the skilled and trained scientist. This is how we misleadingly have come to believe that the scientist has access to some truth and is able to provide correct answers regarding the pre-given Nature.

The Nature may be pre-given or not – but this thesis claims that there is no pre-given knowledge of this Nature. As a matter of fact we take one step further in paper7 No 5 claiming that even if there were some pre-given knowledge – the explicates of human perception (the models) must contain a model of the individual’s brain – and such a model is not observer-independent unless all brains are identical. The latter situation seems very unlikely – especially considering the fact that the individual’s brain develops through private experience – and is dismissed. This means that an observer has no means to decide (neither from our sensations nor from its model explicates) whether Nature is pre-given or not – claims made most famously by both Dummett and Kant.

So there is more to the realist’s worldview other than the claim that the furniture of the world is real and outside. He claims Nature is ontologically pre-given, i.e., it is prior to man’s knowledge. A very plausible assumption but this does not mean that the knowledge of Nature is pre-given and accessible by plain discovery. This thesis argues for the opposite: Nature “contains” no knowledge – the knowledge of Nature is constructed (generated) in the process of observation. For that reason the realists must strengthen the pre-given claim – by another claim: observer-independency of human observation - otherwise an objective science is impossible.

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7 See Collected Paper No 5: “The Subject-Oriented Approach to Knowledge…”
A science that only admits phenomena that are empirically verifiable is the essence of Comte’s positivism. When we translate (model) phenomena into “statements about phenomena” this “prime positivism” conforms to the central idea of logical positivism that allows only for “scientific statements that are empirically verifiable.” This meant a ban on theoretical concepts in scientific statements – but this idea was dismissed by Quine among others and confirms the above-mentioned nullification of the idea of pre-given-ness. The question of Nature’s pre-given-ness and the correctness of the realist’ claim cannot possibly be decided by empirical means.

What we have to do here is rather to take an intellectual decision in this matter. One reason for assuming the world to be pre-given was mentioned above – and classical dualism takes the stance that there are two aspects of the physical world – both an ontological aspect and an epistemological. However we have not paid sufficient attention to the Kantian claim that the ontic world is unknowable and what this recognition meant to the Newtonian paradigm.

We must ask if there really are reasons to include unknowable phenomena in science? Are not such phenomena the very definition of non-science? Probably there “are” unknowable phenomena – but they are neither describable nor thinkable – so why bother? In conclusion science should pay attention to epistemological issues only – not ontological. For the obvious reason the latter have no answers. So on what grounds can we make a decision as to whether “pre-given” is a proper scientific epithet or not – when this very question is not an empirical one? This question can be settled by reference to the scientific principles in use. A sound science must avoid unnecessary postulates – a dictum most famously advanced by Ockham and Newton. We thus exclude both the “pre-given” and “observer-independent” postulates from science and reject the main tenets of the realist’s doctrine. This closes the circle and make us understand how the common sense view of a real and touchable “outside” world misleadingly gave rise to Newtonian scientific dualism with supporting realist’s doctrine – that banned intuition and human feelings in a vain attempt to become objective – in the sense of observer-independent.

2.2.2 The questions asked influences the choice of models.

The SOA has shown the prevailing idea of Nature as pre-given to be unnecessary (and not even useful when we consider it to be a epithet of human knowledge) and regarding the question of the observer-independency of observation the scientific community no longer embraces this idea – a finding formulated by the well-known slogan: observation is theory-laden. In consequence an adequate science must leave these two bewilderling postulates unspoken – and left behind for their eventual later deduction.

So what framework will emerge when building a science without the use of these two above mentioned postulates? Certainly it deserves the name “subject-oriented” since we here depart from the reflecting subject and its immediate impressions (complex of feelings) in the same vein that Descartes and, following on from him, Husserl once did. The “reflecting subject” is a pure process abstraction in Heidegger’s sense - as a first step totally disconnected from some “classical reality.” Such a science will take off from an all-embracing impression of (or in) awareness “contained in” human consciousness as explicated in the paper “Priverse ... ”. As a contrast the realist has the need to locate this “process abstraction” somewhere, and this is why human knowledge in realism is physically embodied in a living being – the material subject.

A subject-oriented science, as proposed, will strictly elevate the principles of holism, i.e., the principle the observer/knower/thinker cannot be separated from its object of observation/knowing/thinking. Luckily such a science in many respects seems to be “alike” the Newtonian science (at least in the non-quantum realm) for the simple reason that classical science is built up from the FPP – in spite of its sworn loyalty to the Newtonian paradigm. However there are some important digressions, for instance the loss of determinism, dualism, truth and the classical idea that the models of science reflect phenomena in a pre-given Nature. The loss of the correspondence

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8 Quine (1951) “Two Dogmas of Empiricism”
9 The definition of being is problematic in such a setting however
10 When we can free our thought from this idea of physical embodiment (expand the subject) – we can allow human knowledge to spread all over its priverse and then the knowledge is once more at the “place” of the object
11 Bohm 1980.
aspects of the truth conception and the loss of the bivalence principle will of course have substantial influence on the logic of human thinking - as will the holistic observer/observed inseparability.

The FPP will in future be the recognized scientific perspective and the spectacular mechanism of “outward projection” will reveal itself as a twist mainly to explain constructivism from the TPP. We can notice a row of “transitions” that are necessary to adopt the SOA:

• [TPP] → FPP
• [dualism] → monism
• [representationalism] → constructivism
• [realism] → instrumentalism
• [ontic object] → epistemic object (complex of phenomena in the mind-frame of awareness)
• [ontology] → epistemology
• [reality] → cellular automaton of the mind (on-side)
• [laws of nature] → laws of mind
• [representation] → presentation (model)
• [physical domain] → phenomenal domain of impressions

This is a profound transition of scientific thinking – or a veritable revolution of our scientific thinking as advocated by Kuhn. We will finally discover that this transition is an expansion of the Newtonian paradigm – in the same way that the theories of relativity expanded the ideas of classical Newtonian absolutism. As a matter of fact the SOA will continue this process of relativisation – as it relativises the truth, entity, state and property concepts.

We must seize upon that the acts of perception and succeeding modelling together aim at the output of conceptual entities that we all can understand. However this understanding is not based on the knowledge of a pre-given Nature but rather on a set of rules agreed upon by consensus. This capacity of consensual communication is achieved only careful upbringing and proper education. What else there is – is hidden to human observation, and therefore also to experimental physics which is the exemplar of science as defined today. However the concentration on a purely empirical experience cannot be sustained – we must openly allow for human imagination to enter into science, for the simple reason there has always been such a place for intuitive imagination in science and that as a matter of fact has always been its very driving force. The most important argument, however, is the finding that the observational/theoretical distinction is not only empty – but also even devastating. This also applies to the inside/outside and object/subject distinction – which has far-reaching implications for logics and the use of languages.

In the SOA, human knowledge build-up is not based on discovery but rather on construction and this model of knowledge production can be understood by considering that there is another way to account for consensual understanding other than the classical assumption of a Nature pre-given and observer-independent. We simply assume that the human brain adjusts by means of conceptual feedback and language adaptation in the ways suggested by the research in the area of neural networks. In that way we can learn to produce models that “look alike” and can be approved of in consensual understanding. In this way we can, in the vein of Wittgenstein, assume the spoken language (or any modelling framework) to be a rule-based “game” – that has a useful interpretation in directing our lives – and the colourful imaginations of human consciousness to be the useful instrument panel (mental model) in this important task. Then the idea of unbiased (objective) observation can be based on the idea of a “well-tuned” and therefore consensual brain. Then there is no way to decide whether the set of human sensations that makes up the core of consciousness are similar or not – nor is there any need. The consensus is then “created” by the acceptance and sharing of the same set of models – and this insight finally explains the state of unease that we felt and the vain quest for a guiding “real world” we accepted in the manuscript “An Intuitive Approach...”

12 Their findings, however, has to be translated into the subject-oriented language
13 Which is the essence of the primacy of subjectivity
In the same way we understand that the eventual pre-given-ness of the “world” for that reason cannot be decided by any human being which also means that the accuracy of this process of imagination cannot be judged in terms of truth/falsity by some “correspondence” to the presumed pre-given original – a presumed comparative process that also rightfully greatly bothered Berkeley.

The reason is that this idea of observation is faulty – it is based on an inconsistent meta-model of modelling and observation. As explicated in paper No 5 a detached (or outside) observer is unable to produce an observer-independent description (model) of the object of observation, which is to say that the detached observer is unable to produce an objective model of the object of observation. This meant that it is impossible to build an objective (in the sense of consensual) science from the position of the detached observer, i.e., from the classical Newtonian position. The situation seemed even worse since it seemed – due to the primacy of subjectivity – that strict scientific consensus was in principle unattainable – until the SOA was tried in practice and almost by accident a loophole was found in the definition of a set of subjective entities (conceptual schemata) that could provide the basis for a consensual science based on the brain’s power of adaptive learning and a set of mutual agreements (models).

By means of a primary definition of a private subjective science (in a boot-strap fashion) it was later possible to build a consensual science based on the idea of monistic scientific instrumentalism that virtually “locate reality inside the human mind” in parallel with a cellular automaton. This idea has been developed in a sketchy manner in some of the collected papers – but it remains to be completed in a more systematic way – and this is probably the first step for future research efforts.

What has been said above in a conclusive manner very obviously give rise to a set of fundamental and interesting questions that are closely connected to the issues discussed in section 1.3 “What is science?” and I find it wise here to conclude this thesis by drawing attention to the most difficult task which lies ahead – to convince a scientific community schooled in Newtonian thinking that a conversion to the SOA is worth while - and necessary. As the OOA – in the form of the Newtonian paradigm is abandoned - the realist’s doctrine become useless and unnecessary – this is why the demise of realism which has been forecast seems unavoidable.

In the wake of this demise – we will also lose the scientific determinism that is best embodied in the ideas of mechanism – that will mean the comeback of the human will into the scientific arena. Computer scientists have by experience learnt that some questions are simply undecidable – the deadlock being broken by the adoption of a human decision.
APPENDIX A.

The choice of the word allusion to appoint the set of phenomena we classically call ‘reality’ or the ‘world’ is motivated by the discovery that this phenomenon – in spite of my convincing everyday experience to the contrary – is an ‘unreal’ phenomenon in every sense of the word. This phenomenon, which most often is called a mental impression, arises in my mind only – as part of my knowledge and is for that reason fully abstract in the sense of traditional realism. Nevertheless this phenomenon cannot be considered a hallucination or an illusion – and I would therefore rather, as an abstract phenomenon, call it a constructive imagination. However an imagination, in most cases, stands for a mental image or concept of something that is not real or present. No doubt the classical ‘reality’ as a basis for my actions has a significant epistemological existence (my priverse), however we will understand this significance has no counterpart in a knowable ontic existence, and can for that reason not be considered certain at all by human knowledge. The existence of some ontological reality must, by that view, be treated as a pure hypothesis, however very probable. The view that the mental impression is erected upon some ‘clues from outside’ in a process of irreversible superposition is workable and very useful as a point of departure to the realist reader new to the subject-oriented way of thinking. According to that view the priverse is not an illusionary wiff of the wind but rather a sturdy concept as a basis for reliable human action, as the record of history shows, and this sturdiness of the clues is reasoned approach for choosing the term allusion to characterise mental impressions and phenomena – rather than illusion or imagination.

allusion

The act of alluding; indirect mention. 2. An indirect, but pointed or meaningful reference. [LLat. allusio, a playing with < Lat. alludere, to play with.]

allude

To make an indirect reference to. [Lat. alludere, to play with : ad-, to + ludere, to play < ludus, game.]

USAGE: Allude and allusion are often used where the more general terms refer and reference would be preferable. Allude and allusion apply to indirect reference that does not identify specifically. Refer and reference, unless qualified, usually imply direct, specific mention.

imagination

a. The power of the mind to form. b. Such power of the mind used creatively. 2. The ability to confront and deal with reality by using the creative power of the mind; resourcefulness.


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AN INTUITIVE APPROACH TO MODELLING AND SIMULATION.

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Abstract:

System modelling is a principal descriptive tool in all sciences. Such a model or set of models is a useful tool for prediction, control, explanation and diverse investigation in both science and enterprise. The observer (or system viewer) is the person defining the system under consideration and its properties and must therefore not be neglected. However in this process of definition there is a tendency to forget the role of the observer and his/her interaction with the system observed. Models are often the bases of inter-disciplinary effort and in this situation inter-subjective communication is of great importance. However great difficulties are often encountered because the participants are trained and educated in very different disciplines.

This paper introduces a novel intuitive approach to the modelling process that underlines the role of the observer of the object or a system under consideration that could be helpful in such inter-disciplinary projects. The main idea is to pave the way for better understanding between the natural and social sciences by making the methodology of computer simulation available to the social sciences – and thus offering them the possibility to, in a sense, become experimental.

The proposed framework supports a good visual modelling analogy, which is easily grasped and could therefore assist in interdisciplinary understanding when making use of models. The intuitive approach proposed can also be used to ease/simplify the actual modelling process.

The relation between systems modelling and computer simulation is elucidated and the role of mathematical models in the social sciences is also discussed.

1. Introduction.

Models are used for description, prediction and control. These are the domains of discourse within areas such as; systems analysis, systems design, control theory, operations analysis, simulation, management information systems, information systems, decision support systems et cetera. The role played by the system observer – or system viewer (SW) - is very important for all scientific inquiry, and in particular when modelling the role is often misunderstood – or simply not included. The requirements specification is a crucial part of scientific modelling that specifies of the system under consideration and very often future predictions or system maintenance are severely jeopardized by neglecting the observer function. Very often the necessary process of abstraction is a source of severe misunderstandings and results in inter-disciplinary conflicts. This paper will concentrate on
abstractions done to reduce the complexity of the world when modelling and thence the clarifications necessary to make use of a model as a tool of interdisciplinary communications. Focusing on such a task, we dwell on the concepts of the system and the model to underline their basic functionality, as the means to support this act of abstraction.

2. Why use an intuitive approach to modelling?

System’s modelling is an activity that requires a clear conceptual framework within which to operate. There are many proposals for formal frameworks for use in systems theory [Kli69, Pad74, Mes75, Wym77, Zei84]. The formal approaches are the basis on which modelling environments are designed and operated. Such environments mostly provide user-oriented facilities that do not require in-depth familiarity with the theory-based concepts. When it, on the other hand, comes to inter-disciplinary cooperation in science, this lack of in-depth familiarity often even turns out to be an obstacle to clear-cut communications. This could, for instance, be the situation when the discipline of computer simulation encounters some discipline of the social sciences. In this situation we find a lack of understanding due to fundamentally different worldviews and the absence of an appropriate conceptual framework to be used. Discussing diverse modelling efforts can be very frustrating. This paper introduces a more intuitive approach to the modelling process, than the formal modelling frameworks normally in use. A crucial idea is to elevate the observer-centred part of modelling and to discuss in-depth the role of the SW and his/her influence on the modelling process. The proposed approach is easily grasped and could therefore better serve as a tool of interdisciplinary communications and for a better in-depth understanding of the modelling process, all at the cost of formal stringency of course.

Many different approaches have been advocated for use during systems modelling. This fact is reflected in the large number of books and articles that have appeared over the past decade and surveys that can be found covering both “soft” [Ros89] and “hard” [Mur90] modelling methodologies. New arguments have often emerged at the methodological level, while the underlying philosophy has remained somewhat controversial, but the advent of the computer and the awakening interest in structural complexity [Nic89] has brought new approaches to the surface. The branch of philosophy of science that deals with modelling the “things of the world” is called ontology (or metaphysics) and we turn to an ontological view to seek a formal base for the notation of a model [Bun77]. In doing so, however, we try to avoid presenting theories for interdisciplinary use in forms too difficult to grasp. The conceptual frameworks of physics and general systems theory (GST) lay out the foundations of modelling and are very mathematical in form. The theories of classical philosophy are most often presented in natural language (verbal models), but when we come to philosophy of science - a collection of intermingled interdisciplinary frameworks – we also meet with frameworks very mathematical in form, especially when they discuss scientific ontology, see Bunge () for instance.

The qualities mentioned here often make them too abstract and hard to grasp to serve as a useful tool when it comes to interdisciplinary communication. In contrast the framework proposed in this paper, supports an appealing visual modelling analogy that could enhance the understanding of the models used and the modelling process as such. This approach also reveals and highlights the often tacit abstractions performed when modelling and underlines the need for a set of clear-cut specifications in that respect.

The proposed framework also stresses the close relationships between scientific activity, systems modelling and simulation methodology also making clear that there is a fundamental difference in their respective development phases: A scientific model is (tacitly) part of a culture of science - a system’s model is a dedicated model worked out from a captured part, object or system in the world of this culture - most simulation models are worked out directly from a model of the system or some requirement specifications – without direct contact with the very phenomenon modelled.

That is, the system’s model has a very important role during the development phase and information interchange processes and the assumptions must be made clear to all participants independent of their discipline. The participants must be trained and educated to participate in a paradigm that has its formation from the basic principles underlying the system and its model and parallel to the strictly logical frameworks mentioned. There is thus a need for another conceptual framework to support the process of information exchange. The IFIP WG 8.1 Task Group FRISCO (FTG) [IFI91] proposes such a framework for use in the organizational area. This framework can be
used partly to support a more intuitive interpretation of the modelling process and their ideas will now be elaborated upon.

Another reason for supplementing the formal frameworks of physics and GST theory and turning to a more intuitive notion is the fact that a purely mathematical approach is not well suited to organizational, economical and societal manipulations. This is so, partly because of the complexity encountered in these disciplines and partly because of the apparent lack of quantitative measures. This situation also enhances the need for computer-assisted computational methods when dealing with organization systems and models in the social sciences. The simulation methodology is, in that respect, very important as it often offers the only possibility to make use of an experimental technique in these disciplines. The above mentioned framework of the FTG could be useful as a working idea to develop a framework within the simulation area, as an aid to clarify and standardize the terminology used within this area. [Kje91].


The importance of models and model building as an integral part of scientific inquiry has often been stated [Ros45]:

-- No substantial part of the universe is so simple that it can be grasped and controlled without abstraction. Abstraction consists of replacing a part of the universe by a model of similar but simpler structure. Models ... are thus a central necessity of scientific procedure.

The notation "a part of the universe" or equivalently "a part of the real world" is usually called a system. The system concept has been extensively discussed during the 20th century but is still very confused - a situation that severely hampers the understanding of the modelling process. Sometimes our cultural habits and/or educational efforts have furnished us with an understanding of how to interpret the ideas involved when discussing such systems. This goes for phenomena such as atoms, particles, computer systems et cetera. However in general such assumptions cannot be taken for granted regarding the system of inquiry unless we run the risk of jeopardizing the model's quality to serve as a tool for knowledge and communication. Except in cases where we can rely on a high degree of consensus concerning the system under investigation, we have no other way to understand the model’s structure and the acts of abstraction undertaken, other than to ask the observer of the system, or the scientists in charge of dealing with the system on a daily basis.

By explicitly representing knowledge about the components of the system and their relationships, the SW specifies his/her particular abstraction of the system. This specification can be made verbally, but is very often done by means of a conceptual framework (formalism) firmly established in his/her scientific discipline. For this reason, it is argued; models are to be seen as a system specification developed in a specific conceptual formalism. The choice of formalism strongly influences the explanatory power of the model and also its possibility to serve as a tool of prediction. That is to say, the correct interpretation of a model assumes familiarity with the modelling facilities and the conceptual frameworks used during the modelling process.

4. The system concept and the perception process.

A cause for confusion when modelling is that we often think about "systems" as something that can be “objectively” decided, once and for all, for example by the specification of its parts and relationships. This is not so. The system and its properties, as seen by the observer, are applied to the system domain, the environment domain, the elements of these domains and the relationships between these elements. Together they represent a system view, which as a first approximation, is strictly personal to the observer. For instance, concentrating on a row of trucks, we could see a useful transportation system. On the other hand, an environmental activist probably sees the row of trucks as a load test of a bridge. A representative from the labour union has another view and so has the physician. There are many possible system views - and this is a simple example. In the natural sciences a row of different views are possible – the physicist’s, the chemist’s, the biologist’s et cetera but when we come to organizations - or other phenomena in the social sciences - the number of possible views is enormous - sometimes as many as there are observers of the part of the real world that is about to be captured.
FTG defines a system as follows:

-- involves a distinction between system domain and system and the notation that systemic properties are only subjective and associated with the system domain by the viewer, when it as a whole is seen as a system. Awareness of this principle is the most important prerequisite to avoid misunderstanding about system.

The most important feature of this interpretation is the stress put on the fact that behind the system view is always a person - the SW - who interprets the world in a certain way. This feature will become clearer if we separate the "system domain of the real world" from the "image of perceived system", - a system image in the mind of the SW.

![Figure 4.1](image1)

The system domain is the source of mapping and we can thus perceive a "system" as in Figure 4.2. I shall call this mapping a projection, to support the intuitive visual analogy of this process.

![Figure 4.2](image2)

We will make a clear distinction between the real world (RW) and another imaginary world (IW). The IW-system is the captured part of the RW world as seen by the SW, that is, the mental representation in his/her mind. The area of interest of the RW is projected via a window of perception into a system image ∈ IW. The IW is the private conceptual world of the SW and as such is heavily affected by the purposes of the SW. This “window of perception” must, of course, be interpreted in its
most general way, i.e., perceptions by means of the senses and their extension in the form of possible physical measuring devices. We will continue to keep this separation between RW and IW in concession to Cartesian dualism and elaborate the system and model concepts accordingly.

Here it is important to note that we in this situation have no means of identifying the \textit{conceived properties of the IW-system} – which is what we normally call \textit{system properties}. These properties are defined by the SW’s “system view” and in the case where this view is not established in a common agreement such properties cannot be found in the RW - in spite of the traditional naïve interpretations pretending so. As a matter of fact it is not even possible to find such a “system” in the RW unless we have a common agreement regarding what counts as the “system” and what counts as the “environment”. We conclude that generally the two IW-images specifying the system view and the system properties are \textit{abstract subjective phenomena} best described as the "inner images" or mental representations which have arisen in the mind of the SW.

Another complication is that the system properties the SW associates with the RW-domain (his/her personal view), i.e., the relationships between the IW-system and IW-environment in his/her mind, \textit{can only be presented (laid out) in the form of a model to the surrounding world.}

So we might rightfully ask: “Where then is the 'real system?'” As seen, there is a RW-system domain, an IW-system and associated abstract properties of the IW-system in the mind of the SW, but no “RW-system” in its traditional sense. The actual system is born, as a fragmentary picture of the captured RW-domain, as an \textit{abstract mental image in the mind of the SW}. What do we then mean by the "real system?" To be useful, this IW-system must also be given an RW-interpretation as a back-projection of the IW-system onto the RW. This projection of the IW-system image onto the RW is the equivalent to the RW-system in its \textit{traditional sense}. The subjective projection “formula”, which gives the personal IW-system view an RW-interpretation, is clearly of crucial interest - but in fact the SW might not even be aware of the existence of such a subjective projection “formula”. When this “formula” is known, on the other hand, it is wise to openly state the rules as to how to accomplish such an RW-interpretation. In this way these rules become the common property of all the involved observers.

But such rules are never explicated – why? Not even the presumed exactness of the natural sciences has called upon such unambiguous specifications. We watch light-emission spectra coming from “atoms” envisioned as a solar system – and photons behaving like tiny particles. We say we do not really believe that they are “real” – that they only behave as if they were. What do we really believe – that they are just useful illusions? In that case what is the justification for the Newtonian way of thinking about “matter” that we now use? Do such illusions also bounce during collisions?

To scrutinize this interpretation and the idea of subjective projection suggested it is assumed that the SW considers the system in the “real world” to be a \textit{closed system}. Such IW-systems are easily created in the mind of the SW (and frequently are) – and such IW-systems can be given plausible RW-interpretations. However a \textit{closed system} can in principle never be observed – which in a sense proves that the system under consideration is a “true” imaginary IW-system (abstraction) and the corresponding “real system” accordingly \textit{a projective illusion} – in this case a plain fantasy. Maybe the “image” of a closed system is not the only imagination we construct – maybe all our images are projections or projective illusions? How could we ever know – maybe the things of the “real world” are mainly the products of our imagination. \textit{This seems to be a crucial question that science hitherto, with few exceptions, has refused to address in a satisfactory way.}

\section{The idea of the real world system.}

For the moment we leave the question open as to whether the RW is just imaginary and concentrate on how we traditionally envision this world. It is well-known that any RW-domain is normally seen as a collection of interrelated parts, called \textit{elements}. These elements are the phenomena conceived in the UoD that we think belong to the RW and when these elements are projected onto the IW-system, we call them \textit{entities}. We thus continue to use the term \textit{entity} as it is normally used in the simulation community. It is worth noticing that when we focus solely on the entities , i.e., disregarding their possible interaction, the \textit{system} disappears so to speak, since such a set of entities devoid of interaction is called an \textit{aggregation}. This is the essence of the \textit{system approach of investigation}.

Knowing that a \textit{system} is an \textit{abstraction in the mind of a SW} we are now able to develop Figure 4.2 further, considering the system domain as the real world seen through a \textit{window of perception}. To
emphasize the presence of a specific purpose for the SW to apply this particular system view, we insert a purpose filter, in this projection path. (Figure 4.3)

![Figure 4.3](image)

Different purposes of modelling will create different IW-images in the SW's mind, i.e., a different purpose filter will generate different IW-systems in the mind of the SW. We can also find further filters in this projection path since processes of simplifying and idealizing are undertaken to reduce the complexity - in fact, all these filters are prerequisites to obtaining a manageable IW-system and are inserted in the observation path by the SW sometimes unconsciously. Most modelling efforts would be in vain without this act of data reduction. We group purpose, simplification and idealization filters together into one observation frame of the SW. Figure 4.4.

![Figure 4.4](image)

Metaphysics is the faculty that studies the most general categories in which we think. These enter our thinking in various ways, including the way we perceive the world, the way language is organized and the choice of concepts to describe the world. When modelling the important categories are space-time, substance, quality, quantity and relation. The categories are in a way a frame of reference within which we can put forward questions about the real world. The category of substance is concerned with material stuff and individual things and as such is concerned in the classification and identification of things. These categories are indispensable helping us to bring order to the perceived complexity of the real world; Nevertheless, this act of classification and identification can differ considerably from one scientific discipline to another. Educated and trained in a specific scientific discipline, we are thus trained to observe the real world in the light of a certain conceptual framework. As a consequence we can find another filter here that influences the projection path, after the passage of the window of
perception. We call this filter an *educational* filter and the idea of scientific paradigm originally coined by Kuhn [Kuh62] pinpoints the existence of such a filter.

We do not even have to be trained in any specific scientific framework to perceive the world in a certain way. In Kuhn’s own words: "one suspect that something like a paradigm is prerequisite to perception itself. What a man sees depends both upon what he looks at and also upon what his previous visual-conceptual experience has taught him to see. In the absence of such training there can only be, in William James’s phrase, ‘a bloomin' buzzin' confusion’." 

Our perceptions are the result of training embraced by long lasting human traditions and cultural habits, and therefore we must insert another filter - called a *cultural* filter. There are also, of course, reasons to insert more filters in this projection path caused by our *personality*, *expectations* and *mental mood*. We call all these filters *psychological filters* and assemble them into a single *personal frame*. This frame is imposed by the observer in person and is truly subjective. To get to the point of consensus that we usually call “objectivity”, we have to exercise a rigorous control to minimize the influence of the personal frame.

The personal frame is different from the observation frame; in the sense that the personal frame often unconsciously adds (or fills in) the data that seems to be missed along the perception path - in a sort of correction phase. We are just in the beginning to understand how human beings process and store sensory information and to better understand the role of the personal frame we must turn to the cognitive sciences and artificial intelligence.

However this is not enough since human conceptualization is so important and therefore we must also turn to metaphysics where the most general ideas used in science and everyday life are investigated. The theories of modern physics such as the quantum theory, the theories of relativity and the theory of chaotic dynamics, for instance have a crucial influence on modelling methodology, especially when it comes to discussions about the personal frame. Figure 4.4 shows that the SW’s IW-system is heavily influenced by the all filters mentioned here and that it is impossible to trace the projection from the real world to IW, without an elaborate specification of what has happened in the perception path of the SW. Inserting a measuring device into this perception path make things more complicated, but has no principal bearing on the discussions which follow.

### 6. Modelling and the model concept.

Next we ask what are the relationships between the mental IW-system and the model? Marvin Minsky once gave a very useful model definition [Min65]:

> To an observer B, an object A* is a model of an object A to the extent B can use A* to answer questions that interest him about A. The model relation is inherently ternary. Any attempt to suppress the role of the intentions of the investigator B leads to circular definitions or to ambiguities about ‘essential features’ or the like.

This definition focuses on the possibility of considering a model as a database system for future questions about prediction and control. It takes the observer of the system into consideration, which is very important and highlights the observer’s intended *purpose of model development* – that has a deciding influence on the outcome of the modelling process. In this light, we argue, the modelling process is *not to be seen as a direct mapping* of the appointed RW-area into a model, as often visualized. The proposed model of modelling (metamodel) very much benefits from the recognition of two distinctive steps:

1) *A projection from the real world into the observer’s mind (IW-system)*
2) *A mapping of this IW-system into a model.*
We call this metamodel the **2-step model of modelling** and when perceiving the modelling process in this manner, we get a useful visual interpretation, which points out, that every model is associated with and restricted by the way it is represented. (Figure 5.1) Every attempt to establish a direct projection path from the RW to the physical model will suppress the role of the SW – and the presence of the SW and his/her “inside” IW-system is vital to the modelling process. Encouraged by this definition and the visual 2-step metamodel we conclude that a physical model is an image, not of the RW-area captured, but of the IW-system as imagined by the SW. Bearing this observation in mind we will modify the interpretation of the model concept to read as:

To an observer SW, the mental system image \(A^*\) is a model of an RW-object \(A\) to the extent the SW can use \(A^*\) to answer questions that interest him about \(A\). The **corresponding physical model** is an “external” presentation of the system image \(A^*\) which has emerged in the mind of the system viewer (SW) – and as such cast in a conceptual form chosen by the purpose of the presentation. Due to computation and/or inter-subjective communication there is a need for an external model.

The process of idealization is nearly always regarded as an imperfection forced upon the modelling process by the complexity and intangibility of reality. A more rewarding posture is to regard this process as a means for the SW to **bring out the essentials of the system under consideration**. This process takes place firstly in parallel with the purpose-filtering, along the perceptual path when the RW-domain is projected onto the IW to produce the system image. Secondly another forced part of this idealization takes place in the modelling path between the IW-system and the model, imposed because here we have to conceptually represent the model – the modelling framework.

The mental representation of the system in the mind of the SW is often called a **mental (or internal)** model. According to the interpretation given above, the notion of a "mental model" is the equivalent of the IW-system concept and we have deliberately called this real world-projection an **image** (or mental representation) to leave the concept of a physical model to denote a "real" phenomenon "outside" the SW. That is to say, **not until the IW-system is laid out in some conceptual framework could we speak about a physical model** – the reason is obvious: **A physical model is then always a non-abstract presentation of some captured real world-phenomenon**.

The form of the presentation is generally chosen with respect to the intended receiver and the conceptual frameworks available to present an IW-system are numerous, each one displaying certain facets of the portrayed RW and relevant to dedicated receivers. We derive further advantage from the 2-step model by the ease of exemplifying the use of different modelling formalisms. This, we visualize by inserting another filter, called the **conceptual frame**, into the projection path as shown in figure 5.2. We insert, this filter on the path between the IW-system and the physical model and there it is possible to find different filter components such as the medium of communication - the purpose of modelling – and the receiver of the model and so on. However here is not the place to develop this subject matter any further.
Models are categorized in different ways, the broadest scheme classifying them as ionic, analogous or symbolic. Such models do not necessarily have to be expressed in a scientific formalism, we can just as well chose an expression of a natural language, such as sentences, which is called a verbal model. A picture, photo, sketch or graph are also clearly very useful models. A change of conceptual filter is equivalent to using another presentation form and this will in turn changes the whole presentation. When changing from one filter to another, we can generate a whole spectrum of different types of models outgoing from one and the same IW-system. For instance we can set out a mathematical, statistical, conceptual, logical or verbal model – it is our own choice. (Figure 5.3)

The careful choice of conceptual filter is a very important step in the modelling process and each scientific discipline has its own favourites of well-known modelling filters that are, on a regular basis, used to project different IW-systems into a familiar conceptual form. Thus the model's ability to serve as an efficient tool for knowledge communication within the scientific discipline in question is maintained. We conclude that a physical model is a very important knowledge communication tool.

The different filters must not necessarily be interpreted as conceptual filters whose output is only of significance to a specific scientific discipline. The filter set could just as easily be chosen as to cover a spectrum of models at a different level of abstraction. See for instance [Fish89]. The use of such a
modelling strategy is proposed by B. Zeigler [Zei84] among others. Different filters are also used regularly to produce a conceptual standard output belonging to different well-known modelling methodologies, e.g., the entity-relationships-models, object-oriented models, industrial dynamics models, flow graphs and so on.

7. The model interpretation and non-formalized languages.

There are certain types of knowledge that cannot be laid out in the form of model. Knowledge related to intuition, feelings, creativity, artistic performance etc. belong to this category. For obvious reasons difficulties are met to describe this knowledge-category sometimes called *empation more specifically*. Management science often refers to this category as "know-how" or "fingertip feelings" and is often used to explain the "untouchable" skills of an experienced manager. The FTG group defines knowledge as "that, which is known by human beings" and thus states that *information* and *empation* are two complementary subtypes of knowledge. Information is defined as: "the formalized knowledge of states in a system that can be transferred in a reproducible way and with complete certainty." Thus the eventual "non-formalizable kind of knowledge" contained in an observer’s IW-system could not be part of a model since the *empational part of the knowledge cannot be projected into the model by definition*.

(Figure 5.4) Here we find another filter, an information filter, which is transparent only to *formalizable knowledge* revealing that a substantial part of the SW's subjective experience and knowledge can never be incorporated into a model. To put this partly fragmented knowledge and unconscious skills into a useful form is a challenging problem dealt with in decision-making and AI.

![Diagram](image)

Figure 5.4

When an IW-system is shown in the form of a model, then the knowledge and experience “contained” in it is explained to others. When I, as person A, present my model to another person B, it becomes the RW domain for another SW, namely B. (Figure 5.5) In this situation it is important that the observation frame of B is as transparent as possible. That is, B must know my objectives and purposes to be able to interpret the model correctly. However this is not all, B must also be able to find out or imagine all other abstractions I have done – deliberately or not. My observation frame is possible to describe and take account of, but things are different when it comes to the personal frame, which can hardly be removed that way. The educational filter – imposed by the paradigm - will always be a particular obstacle for interdisciplinary understanding and this is why physicists, for instance, do not understand economists very well and vice versa. When B tries to interpret a model displayed and formulated by me, the personal frame of B has a somewhat different role: The personal frame of B is responsible for creating an imaginative IW-system in the mind of B, for filling in all tacit assumptions, abstractions and details missing in this observed simplified model description. A truly creative and

\[1\] German: Finger-spitzen Gefühl

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intuitive task, which relies on both educational and cultural experience and habits, will always cause interdisciplinary research to be awkward. In our attempts to bridge the gap, we often try to improve the explanatory power of our models with graphical presentations and/or stating some verbal models in parallel – in consequence most of our modelling attempts are multi-faceted, a term coined by Zeigler [Zei84].

![Diagram of a queuing system with p-frame A and p-frame B connected by o-frame A and o-frame B, with RW-system and validation model.]  

Figure 5.5

8. The intuitive approach - some illustrative examples.

To illustrate the ideas presented above, in the following we will capture some areas of the RW, chosen to pinpoint the influence of different frames exerted on the projection path of modelling. First a very simple phenomenon found in the real world, a single server queue. The scenario could be given as a verbal model:

"A single server queuing system consists of one server unit that provides service of some kind to arriving customers. Customers who arrive to find the server unit busy, join a queue in front of the server unit. Such scenarios are, for instance, found in banks and post offices, manufacturing lines etc."

Such a queuing system consists of two parts: a queue and a server unit. Contemplating such an open single server queuing system our ideas, by virtue of daily experience, are presumably very similar and this IW-system could for instance be modelled in the following way:

![Diagram of a single server queue with queue and server unit, connected by arrows.]  

Figure 8.1

Figure 8.1 is a common conceptual form of a physical model, a picture, and its explanatory power is brilliant but on the other hand its predictive power is very limited. How come the explanatory power of this simple model is so good - just three small figures and three words? There are two obvious
reasons: Firstly, we can all interpret the meaning inherent in this sketch and secondly it illustrates a well-known RW-phenomenon from which we all have great experience. That is, when observing this model we are, by means of cultural habits and experience, able to apply a personal frame that creates or reinstates a universal IW-image of a single server queue. However this is not self-evident - it is the marvel of human communication.

The system view - the domain of investigation:

When we capture such a simple part of the real world, we have no difficulty in identifying the parts and their relationships. Queuing systems can be characterized in terms of entities queues, service stations and customers. To handle the input to and output from the system, we also often add entities that are not equally self-evident such as sources and sinks. By concentrating on different concrete things (objects) that are known to exist in this RW-area, then we can specify the different abstract entities belonging to the IW-system. We call this the object-oriented view of this scenario – because the actual objects of the world are taken for granted.

This is not all, however, because by this choice we have also decided on a particular system view - a choice as to the level of decomposition. We specify that we have no interest, apart from the service times, in the inside of the server unit, which is a very complex phenomenon. We also take a decision to consider the customer as an "atomary" element. That is, although the customers themselves could also be regarded as a system (or subsystem) we are not interested in further subdivisions. We thus apply an observation frame that filters out all details below a certain level and this level is not decided by some geometrical dimensions but rather by the purpose of the investigation.

In this IW-system we can readily identify three important entities: customers, a queue and a server unit. We can, for example, present this IW-system in two different forms by drawing the system domain boundary in different ways:

![Figure 8.2](image1.png) ![Figure 8.3](image2.png)

By removing the environment domain and hence also the input and output to the system domain, we get the image of a closed system:

![Figure 8.4](image3.png)

What about the rules to decide whether an object belongs to the system or not? Here a common modelling trick is used, where the elements are created and consumed inside the system by means of a source and a sink – thus all entities belong to the system. However we can observe the use of an idealizing filter when approximating the behaviour of the arrival process and the service unit by means of the statistical distributions as expressed in their mathematical form. The SW does not belong to the
system and we regard his/her acts of observation have no influence on the system’s function. However this is not always the case when watching human systems.

The block diagram is another model:

![Block Diagram](image)

Figure 8.5

Leaving out some details of the captured real world-area, the block diagram is used to show the process view of this scenario.

The modelling path - the conceptual frame:

It is very rewarding to notice how the choice of conceptual frame influences the outcome of the modelling process. We often choose a certain modelling approach guided by the possibility of future computational solutions and/or the presence of an appealing conceptual framework, for instance mathematics with its accompanying possibility of numerical experimentation. Simulation methodology here offers a very appealing alternative. Such considerations reveal that the choice of conceptual frame is important and sometimes enforces both unnecessary and restricting abstractions that can influence the whole investigation.

Let us, as an example, have a look at the mathematical formalism used in statistics: In a queuing system the arrival process is characterized by the time distribution between the arrivals of successive customers. The two most important cases are, when the times between arrivals are exponentially distributed and when they are constant. When the time between arrivals is exponentially distributed, its probability density function is:

\[ p(t) = \lambda e^{-\lambda t} \]

where \( \lambda \) is the expected mean time between the arrivals

The traffic intensity \( \rho \) is defined as

\[ \rho = \frac{\text{mean service time}}{\text{mean time between arrivals}} \]

Let the mean service time be \( s \) and the standard deviation \( \sigma \), queuing theory gives the following queue characteristics as a solution: mean queue length \( (w) \), mean queuing time \( (t_w) \)

\[ w = \frac{\rho^2}{2(1-\rho)} \frac{P}{P} \]

\[ t_w = \frac{\rho s}{2(1-\rho)} \frac{P}{P} \]

\[ F = 1 + \left( \frac{\rho \sigma}{\sigma} \right) \]

This is very much the normal view of a queuing system as presented in Figure 8.2. Here the conceptual filter in use obviously blocks out all the other possible attributes we can assign to a customer, leaving just his "property of oneness" intact. This type of abstraction lumps the behaviour together into two average values (attributes) that are attached to the queue entity, i.e., is seen as a property of the queue. This act of abstraction is clearly recognized by the structure of the block schema above. By lumping the individuals together we create a new type of entity – the queue – we witness the emergence of a queue. This queue interacts with the service unit (see block schema) – and the service unit is another emergent object that “comes out” of the behaviour of its parts. Which view is the correct one – or rather the most useful one? This question cannot be addressed until we know what questions about the system we are supposed to answer. Since the conceptual frame here forms the modeller’s personal system view we here can trace the tight connection between the conceptual and personal frame – the conceptual framework in use influences the worldview of the modeller.
The perceptual path - the personal frame as part of the observation frame:

To exemplify the use of filters in the perceptual path, we consider the system view B above and we dismiss the "queue-view." Suppose, for instance, we are instead modelling individual humans in a specific area of the RW, for instance customers lining up in a queue in front of a bank teller. Suppose the purpose of this investigation is to store data about the customers in the bank’s database. Such a system view has a well-defined area of interest and the level of decomposition seems here self-evident. The properties attributed to a customer could be, for instance, a name, a year of birth, a salary and savings. By doing so we use the observation frame to filter out all other properties we otherwise could ascribe to a human being – concentrating on the customer aspects. As a second step we also have to specify a set of underlying domains and assign to them a range of possible attribute values. This is an act of filtering, the knowledge of which is given by the personal frame – our experience. When we, for instance, add the attribute of “hair colour”, then we suddenly find ourselves involved in a messy situation trying to classify hair colours – for no practical use at all. But how do we know?

Well after solving all these problems the IW-system could, for instance, conceptually be specified by a specific set of attribute values assigned to an individual that in systems engineering is called a record. (Figure 8.6)

Another facet of the same system view occurs when we consider the number of customers lining up and here the idea of a number offers a good opportunity to display the role of the personal frame. We are all very familiar with these words "one," "two," "three" etc. but what objects do we assign those names to? Consider, for instance, the number "three." We all have the intuitive idea of “three-ness.” The mathematicians turn to set theory to sort this out, considering the set of all sets having exactly three elements. They all have in common the property of three-ness. In this way we try to convey the idea of N-ness to the number N. (Figure 8.7)
That is a natural number \( N \) can be interpreted as a model of a set containing \( N \) elements. In fact, every set containing \( N \) elements is modelled by its cardinal number \( N \). In this case we can observe a magnificent abstraction. Every possible property to assign the individual element of the set is filtered out, except their "property" of one-ness, which is given to them as individuals, i.e., the individual has cardinality "one". Then this group of individuals is collected under the name of a set which in turn is attributed the single property of cardinality, which is assigned a value between 1 and some very large number indicated by \( \infty \). So a number is a property value that we assign to sets – objects that are devoid of other qualities but cardinality. We must credit the personal filter with this ingenious act of filtering and we now start to understand that the "property of oneness" that is attributed to each element of the set is just a reflection of the level of decomposition chosen by the SW.

This interpretation also provides us with a model to visualise the use of different number systems. The mental idea of a number could be projected by means of different conceptual filters into different symbolic representations. (Figure 8.8)

**9. What happens to reality?**

We now begin to understand that most properties (qualities) attributed to an object of observation are reflections of the worldview held by the SW. In last section we even demonstrated that the conceptual entities identified in the UoD were a matter of choice of the SW. Now when the concepts we use to form the quantitative measures we also assign to our observations – the natural numbers – this mostly seems to reflect the level of decomposition chosen by the SW. That is the personal frame of the SW seems more and more to be the reason why he/she sees the world the way he/she does.

When we try to model a piece of landscape onto a sheet of paper – producing a map for instance - the filter action of our personal frame is even more predominant. Here we tend to regard the percept of
An Intuitive Approach...

this landscape, i.e., the IW-system in our mind, as the “true image” of the landscape. However both filtering and corrective processes are undertaken on the perceptual path on the way to the mind and we must turn to the cognitive sciences to come to grips with the personal frame and its role in human observation.

We should take care to notice that here the notion of the “true image” of the landscape, can only stand for the SW’s image – the IW-system.

The land surveyor, for instance, specifies the area of interest, the specification of the geometrically interesting parts of the landscape and we observe the presence of the purpose filter, as he does not map non-stationary objects such as cars, human beings, animals, etc. However the most important part of the filtering occurs in the conceptual frame, which is established by the rules of mapping given by the land surveyors. The normal three-dimensional space is filtered away and replaced by one dimensional lines of altitudes and all colours including numerous confusing details are left out. The level of decomposition is given by the purpose – hills, paths and lakes and so on are included but stones, trees and flowers are left out.

10. The use of models.

A given description or presentation form thus qualifies as a model in some respect of the RW, when a projection (mapping), which is homomorphic with respect to the relationships involved, is established from relevant phenomena of the RW to the formal representation of the abstract system entities. The projection is done via the SW and is affected by the objectives and limitations of his/her particular system view. Every model description consists of at least the following three principal components:

- A set of abstract phenomena (entities)
- Relationships among these phenomena
- A homomorphic projection that gives the phenomena a real world interpretation

Figure XXXX

The mental representation – the IW-system – must be explicited to become the subject of intersubjective discussions and this model we have called the concept2 model (c-model). We thereby assume there is a basic conceptual (or philosophical) level of understanding (meaning) that can be modelled (explicated) apart from some more syntactic traits included in the modelling framework used. The modelling of objects in object-oriented programming (OOP) seems to be such a basic approach. Such c-models are used at a more basic level in the process of understanding, prediction and control and to be more specific, there are reasons to develop c-models for:

a) - Making predictions regarding a phenomenon or system

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2 we cannot use the term conceptual model for the reason it means something else
b) - Making appropriate decision and taking actions by which, for example a phenomenon or system can be controlled

c) - Making experiments with existing or planned system (system simulation)

d) - Understanding the structure or/and the function of a phenomenon or system

e) – Finding out the boundaries of a given scientific theory

f) - Prescribing operations by which a desirable artificial object or system can be constructed (systems design)

Regarding the points d) to f) the central feature of modelling is a contribution to the understanding and experience of the phenomenon in question and the resulting model could then be used for the sake of communication and education. Turning to the points a) to c) we intend to use the model somewhat differently – as a calculator or predictor or an aid for such operations. Using the model for predictions, we in the abstract feed our models with some sensible input values and calculate some output values that represent an estimated future state or behaviour. When the c-model is a mathematical or logical model we have to solve the model equations analytically or numerically. This is nearly always a difficult task and can only be used for simple models. In physics using RW-experimentation – a methodology that has become central in modern natural science, circumvents this difficulty. Through f the modern computer we have learnt to “imitate” RW-experimentation (or RW-behaviour) – which was the original meaning of simulation, we make experiments with the model to observe the model's response and are accordingly able to draw conclusions from these experiments.

11. Computer simulation:

The simulation technique makes uses of computer programs and computers to do simulation experiments and when the complexity builds up this is sometimes the only way to handle the situation. We argue, that modelling and simulation are two separate tasks. The c-model and the realized simulation model- let us call it the s-model for short, are different at the fundamental level and there is a need to keep the two notions apart. The fact is most easily seen by understanding that a c-model can be the source of many different s-models, all intended for use in simulation experiments.

Simulation has its roots in the analogue simulation technique, which means, that the model used analogously resemble the RW-system in question, e.g., when we use the water analogy of electromagnetic current to explain these phenomena in physics. In digital simulation, as a contrast, the s-model takes the form of a computer program and the simulation experiment is accomplished by the execution of this program on a computer. Here is not the place to delve more deeply into simulation methodology but there are reasons to place this useful methodology in its proper place in the chain of observation-modelling techniques available to science. To explain the usefulness of the intuitive approach to modelling as presented in this paper, we will however use it to explicate the relation between modelling and the simulation methodology.

The normal technique used to develop a s-model is to start with a well-known physical or verbal c-model and develop a computer program that resembles the c-model in some respect – that is we develop a model of a model. It is important to notice that now the c-model becomes our new RW-system and to develop the s-model we have to accomplish another modelling process, different to the one producing the original c-model.
S-models are developed in some computer language, an all-purpose language such as Pascal or C++ or more a dedicated language like SIMULA or GPSS. In this case the choice of programming language is unimportant. However the crucial point here is the person B (in figure 8.1) the one developing the computer program. When the same person develops the c-model and the computer program (s-model), we have the same filter set A in use in both steps. When we, on the other hand, ask a dedicated computer programmer B for assistance, a person that was not involved in the original development of the model or for some other reason was not acquainted with this way of modelling, we have to face a new set of filters both in the path of perception and modelling.

This deceitful four-step projection-modelling path is the cause of many unsuccessful simulation projects and we can find no better way other than through this figure, to point out the desirability that the same person is the one developing both the c-model and the s-model. That is to say that every scientist building simulation models should be an experienced programmer in exactly the same way that we have assumed every physicist to be a skilled mathematician. This situation pinpoints a well-known problem in present day research – a researcher’s lack of modelling skills. We can push this situation to its extreme by asking what is the use of a researcher who cannot use the spoken language? The situation is a bit precarious because to gain the programming experience to be able to develop effective s-models takes time as it does to master mathematics. This fact offers a partial explanation as to why simulation technique is mainly used in sciences that are close to mathematic/physics and thus also to computer science.

Perhaps it is unrealistic to ask every researcher willing to use simulation techniques to gain this programming experience. Clearly the solution is to further develop tools and techniques that make it possible to develop simulation software without the need for extensive programming. However some further reflection makes us understand that programming experience is not the key point here – what is needed is the understanding of the modelling process and that cannot be improved merely by the development of new tools. What we need is a deeper insight into the different aspects of modelling – and recognize the crucial and determining role of the observer.

Another approach is to pose the question: What is the role of the c-model and its relation to reality? Is there really a need to develop c-models as an intermediate stage when developing s-models? Could we remove this step, thus the cumbersome 4-step projection will be replaced by a 2-step metamodel of modelling which will surely benefit simulation methodology. This insight has fundamental implications for the modelling process and offers future possibilities to extend the use of simulation techniques. This research has already been partially addressed by the AI-community but the parallels between computer simulation and AI have not yet been fully recognized.

The next step, when developing simulation models is to prove the correctness of the simulator. That is, to verify that the s-model, the computers and the experimental techniques to be used in the simulation experiments are correct. This process is called verification and stands for "validation of the s-model " relative to the c-model used. The change of terminology is well founded, as this is principally a different process from the validation of the c-model. When verifying we have access to

Figure 8.1
the structure of both the c-model and the s-model and can make direct comparisons. The validation process is experimental and can only be based on a comparative observation of the output values and trajectories of the c-model and the real world, under certain given experimental conditions.

12. Model validation

Traditionally we say that the modelling process has not ended until another important process is carried out - the validation process. Such validation is concerned with the correspondence between the physical model (or rather the intended set of models) and the observable RW. Validation is concerned with determining whether the physical model is an accurate representation of the RW system under study. If a model is "valid," then the decisions made, aided by the model, should be similar to those that would have been made by physically experimenting with the system – if this is at all possible.

However a poor performance is not always due to an insufficient philosophical understanding of the RW-phenomenon under consideration – it could very well arise from the inappropriate use of the modelling framework. This situation has been very obvious in the simulation community where the modelling path has, for practical reasons, always been split up in a 2-step procedure (figure 5.5). The reason is that the computer programmer is a specialist in programming and is often not very familiar with the RW-system he is supposed to model. In building the model, it is thus imperative for the modellers to involve people in the study who are intimately familiar with the operations of the actual system. To make this situation clear we introduce a 2-step procedure along the modelling path – the first step is the explication of the mental model of the observing scientist, a concept model, and the second step "transforming" that c-model into a computer program. We say we realize the concept model. This realization step must not necessarily have anything to do with computer programming. The need of this step could as well rise when developing a mathematical model or a verbal specification.

By recognising this the validation model also splits into two steps: validation and verification. Figure 8. Verification is determining that the realized model performs as is intended, i.e., that the c-model is correctly translated into the realized model, for instance the debugging of a computer program. Even if verification is simple in principle, debugging a large-scale simulation model is a difficult task. Validation, on the other hand, is concerned with determining whether the c-model is a good representation of the RW-system under study. A model is considered "valid" in this respect when the decisions made using the c-model are "similar" to those that would have been made by physically experimenting with the RW-system - if such a system was available.

Some authors extend the validation process to also include the socio-cultural aspects of validation: When a model and its results are accepted by its user community as being valid, and are used as an aid to making decisions, the model is said to be credible, see Carson (1986). The importance of model credibility is one reason for the widespread interest in animating simulation output since this provides an impressive output to the decision maker and an uninitiated person. For these reasons the simulation community frequently considers the problem as to how to make a model "valid" in its widest sense, including the processes of verification, validation, and attaining credibility. In the case where a model fails to pass these tests any conclusions derived from the model will be of dubious value.

Since any simulation model we develop is only an abstraction of the real system being studied, we should always retain a healthy scepticism about the eventual correspondence between the presumed RW-system and its realized model. Frequently it is impossible to compare the RW-system and the physical model structurally and the model is said to have validity if the output measures of the model have close correspondence to the same measures of the real system. For instance a time-series of output data from the model can be compared to some historical data produced by the RW-system. However this approach is not unproblematic as Hoover/Perry points out:

An often-cited criterion for judging a model’s validity is the ability of the model to duplicate the past, the present, and possibly the future behavior of the real system. This may not be a very useful operational criterion and can, in some cases, be an inappropriate criterion for judging the model. Simulation models often exclude certain real world aspects of the system because they do not bear directly upon the questions the model is intended to answer. By not including these parts of the real system, the model becomes a much more useful decision making tool. There is no one set of universal
criteria for evaluating a simulation model, but whatever criteria are finally selected, they should reflect the intended use of the simulation model and the questions that the simulation model is expected to answer.

We will here underline the assertion that the “intended use of the model” and its “capacity to answer questions” are the criteria that should be finally selected, which immediately connects us to the question: “What is the aim of modelling?” with its obvious scientific undertones. What the relation is between the RW-system and c-model seems to be the deciding question here. However we cannot dwell on this issue any longer as we merely conclude that when discrepancies are found one has to repeat the perception-modelling procedure. This process is called successive refinement and reveals the iterating nature of the modelling process.

13. The use of mathematical models in the social sciences.

There are many ways to describe or display models that fulfil the requirements given above and one could rightfully ask why one form should be chosen over another. In practice the choice made is often guided by the paradigms and habits set up by the community of the scientific discipline involved. Since the time of Euclid, however, the very ideal of science has been that whenever possible, it should attempt to make use of mathematics and mathematical models to represent the quantitative knowledge we possess about the real world. A mathematical model enables the quantitative relationships between the different concepts defined in the model to be specified – and has become very precise on the basis of its consistent use of basic definitions. The mathematical model is the undeniable scientific ideal, but we must ask whether this ideal has the same significance today. Hundreds of years ago when paper and pencil were the obvious means of presentation and communication, the very compact and unambiguous language of mathematics was probably the ideal choice. It is well-known that mathematics is very useful today but the development of modern computers and computer software has given us totally new dimensions for modelling. We must understand that this invention has made it possible for the social sciences to become experimental in the form of simulation experiments.

The usefulness of mathematical models in physics and technology is well documented and the origins of the mathematical model can be traced back to physics. Since the days of Galileo and Kepler scientists have consequently striven to develop their models by means of mathematical formalism. The widespread use of the abstract mathematical language of physics has sometimes imposed a belief that mathematical formalism is the only true way to describe the real world - or at least highly desirable. Mathematics and physics have developed hand in hand, and the evident purpose is to describe the real physical world. Objects in motion are idealized as particles. The idea of vectors, which is the origin of the state space approach, is a convenient way to describe bodily motion and forces in the four-dimensional time-space independent of the system of reference. Once we grasped the general rules governing motion we started to investigate the interactions responsible for such motions. To describe these interactions we introduced the field idea, which meant that the cause of a physical property was extended over a region of space. Two of the four different types of interaction known today, gravitation and electromagnetic, lend themselves to a fairly simple field description and these fields are frequently approximated to be both homogeneous and time-invariant. In this world however, the object is taken for granted – and is the very basis of human conceptualization.

When we turn to the social sciences this RW-view is of less use, there are no particles, no well-defined spaces and no homogeneous time-invariant fields. The attributes met with here lack conceptualization which of course is the very reason we meet with few measurements in these disciplines – and thus it is unlikely that mathematical formalism is an appropriate conceptual framework. There are many spheres of human activity where mathematical formalism does not fit well and can even prove to be an obstacle to further developments. Here we also find researchers who are unfamiliar with mathematical formalism or are unwilling to use it for a variety of reasons – and they are also likely to be sworn opponents of simulation.

When we turn to qualitative and heuristic models, on the other hand, they tend to deal with classes of concept and the relations between them is conceptualised to propagate attributes and values among them through acts of communication. The object-oriented programming paradigm uses a similar approach and this specification technique is intuitively much easier to assimilate for non-mathematicians. Computer science and programming have evolved tremendously over the last decade.
and there is no longer a strong reason for the exclusive use of mathematical models when modelling . On the contrary! From the point of view of the social sciences benefits can be gained by trying to find out concepts that are more easily visualized and grasped and also methods that are anchored in a non-mathematical framework. Computer science offers an alternative but the process-oriented worldview used is also, in a sense, very technical in its approach. For a non-mathematician the object-oriented worldview is easier to grasp and this worldview also supports a homomorphic projection of the model onto the real world that is so often desirable in social science. When everything comes together it is a question of communication and it is only possible to have discussions by means of a framework familiar to both ends of this human communication link.

14. Conclusions

The professional conceptual frameworks within systems theory and other closely related areas are too abstract to be used for communication. Such a framework must be easy to grasp at an intuitive level rather than a strictly logical structure and could therefore benefit from an appealing visual analogy. The most important thing here to achieve is a high level of a consensus - not just within the actual discipline involved but also between different scientific disciplines. The framework proposed by the FTG, is a step in this direction and this framework was used, with adjustments, to develop a model of the modelling process that highlights the role of the observer. By the explicit introduction of a 2-step metamodel of modelling, the potential to explain the fundamentals of the modelling process and communicate the ideas involved was considerably enhanced. By introducing a “filter analogy”, each stage representing a step in the modelling process was brought out and the parallels to cognitive psychology became very obvious – not a surprise since the information-processing approach also dominates there.

Using the intuitive approach, however, we very soon reached the point where it was unclear which domain the observer was referring to when modelling – the RW or the IW. Sometimes we almost found ourselves in a state of total confusion as to whether the real world we all refer to when doing physics for instance is nothing other than a projection. Here we identify an urgent demand for further research.

The intuitive approach used also elevated the conceptual filters’ restricting influence on modelling, and revealed that the main obstacle for an interdisciplinary understanding is the filter of education – the paradigm in use. The natural language is a formal framework we have in common in a language culture, but this situation unfortunately does not remove the filter of education. One way to remove this filter is to develop a common conceptual scientific language of communication that is readily understood by us all.

The proposed modelling approach also gives simulation technique a proper interpretation, as it makes a clear distinction between the different concepts of c-model and s-model, and pinpoints that modelling and simulations are two quite separate activities. The proposal also indicates it could be fruitful to focus on object-oriented rule-based models rather than the classical mathematical modelling and simultaneously develop an experimental simulation methodology for more widespread use.

Mathematical formalism was imposed by the tools we had available during the 17th century namely paper and pencil. Today’s tools are computers and the graphical possibilities offered are dynamic, coloured and three-dimensional pictures on the computer screen. We need mathematics to calculate the coordinates on the screen but we must not assume that it is necessary to model social society. When this technique is further developed, then the experimental methodology of computer simulation will become more generally available to both natural and social scientists. To support such a development there is an urgent need to develop a conceptual framework of modelling to be used when developing models for simulation. We propose that this framework could be guided by the worldview used in object-oriented programming with great care being taken to ensure that an intuitive approach to modelling is encouraged. From the natural sciences viewpoint it is highly desirable that this framework is also compatible with the terminology used in general systems theory, control theory and AI.

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DOES NETWORKING REPLACE SYSTEMS THINKING - OR IT IS JUST ANOTHER FACET OF COMPLEXITY?

- a proposal for modelling the phenomena of the social sciences and industrial marketing

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Abstract:

Network and complexity are fuzzy terms often appearing in the very same context, most often when discussing large complicated systems and/or intricate phenomena. The relation between networking and systems thinking is discussed. Approaching large and complex systems we meet with another limitation; the ability to mathematically model and analytically solve the equations. This situation is often met with in the social sciences and the computer simulation technique here offers an alternative, the merits of which has not yet been fully recognized. This is likely the point of a dawning shift of a paradigm; when explaining the phenomena of the social world mathematical modelling and succeeding analytic solution are readily superseded by conceptual modelling and dynamical simulation experiments. The Swedish Network Approach of International Marketing is taken as an example and the facets of data abstraction is used to illustrate the fundamentals of simulations modelling.

1. INTRODUCTION.

The term network has become the vogue in describing contemporary organizations and another phenomenon characterized by extensive interconnected-ness. Typically, the term network is used to describe an observed pattern of connection, often by means of a graph very like fishing net and this is probably the root of this striking metaphor. This idea is, so pervasive, that it has entered a new English verb, networking, which is used to express the idea of a set of objects having lots of connections, acquaintances or friends. The Internet computer communication network is an illustrative and current example. In the hands of some scientists this idea is said to pave the way for an entirely new paradigm, different from what is assumed in traditional scientific theories. This is not the case, we will argue, the network idea certainly does not introduce anything new, it is just another word for the well-known (but sometimes misinterpreted) term of system - at most reflecting another point of view on a system. To consider a phenomenon from another point of view clearly creates a difference but could hardly define a shift in a scientific paradigm in its Kuhnian sense. This observation also reveals that we within different scientific disciplines already have an immense experience dealing with the conceptual of idea of a network and related phenomena - but then rather under the heading of general systems science (GST).

So the question often posed, what account for this enormous contemporary interest in networks has an obvious answer; The idea of a network has arisen from the ideas of how things are connected and work together, i.e., how they are interrelated by descriptions of the mechanisms or forces of how
different items are connected to each other. This interest is not new - not even modern; this is the very purpose of science – even if here reformulated in the abstract by GST. So our "newly awaken" interest in networks has the same background as our "newly awaken" interest in _complexity_ - our predilection for fanciful buzzwords. Unfortunately an indiscriminate use of concepts like systems, network and complexity threaten to banish them to bare gleaming metaphors, if applied so loosely and for no other special reason. Such a use of concepts is bewildering and does not help the process of communication. Such a use could hide underlying familiar aspects of the phenomenon under investigation so fully that we start to develop new tools and framework to deal with the phenomenon and in consequence just "reinvent the wheel," so to speak. Surely there is a great deal to learn about different patterns of connection whether we call them networks, organizations, organisms, complexity patterns or anything else, but we learn nothing new from the bare renaming of already well-known phenomena. Since many of these fuzzy terms are merely different terms for the well-known _system notion_ we should rather stick to the use of it. With this recognition we find whole a science, namely GST, the tools of which now find a new area of proper use – the application to "networking".

Complexity is another interrelated term often emerging in the context of large interconnected systems. Unfortunately the also term complex is used to designate a whole spectrum of observed phenomena or thought patterns used to relate various elements (or objects) of different systems. This is a sometimes-annoying part of our everyday experience since the problems we try to solve often involve elements of unbounded interrelations and inescapable competing behaviour. The conceptual framework used when discussing complexity is also bewildering and many modelling attempt has been severely hampered by this situation. A need for a consistent framework when discussing complexity is often apparent from other perspectives but modelling and resolving this fuzzy term into its more workable _structural and behavioural elements_ can sometimes easily disclose the hidden forces defining many a complex phenomena encountered in various scientific disciplines.

Systems, and especially networks, are mostly visualized by means of graphs and are analytically treated in the realm of mathematics. We will argue, the complexity found dealing with complicated networks and systems today also calls for computer experimentation and simulation as a useful substitute for and extension of the traditional approach of mathematical modelling. Are we looking for a coming or possible shift of paradigm, the claims is the shift is to be found precisely here. For sure this is a minor one to most natural scientists and technicians, but huge and very important one to the social sciences as a whole. This is the way the modern computer has opened to the social sciences to become experimental. In that connection the social sciences can also turn to the ideas and methods normally used when dealing with dynamical systems, involving phenomena like boundless indefinite structures and chaotic dynamic behaviour. However the need for complex mathematics is here not at hand at all – simulation methodologies are based on conceptual programming languages – some of them easy to learn and easy to use.

However this technique requires some familiarity with data structures and for that reason this paper will discuss some aspects of the modelling of networks from another perspective but the one normally found – namely computer science. We will apply the conceptual framework of computer science and focus on the _static structure_ and the _dynamic behaviour_ of the network in question and will also concentrate on some feasible modelling approaches. Since the definition of _abstract data structures_ is an efficient mean to disclose the interconnectedness of a network and we will also touch upon some computational methods that could be useful in dealing with such networks. In spite of the recognized equivalence between the concept of system and network and the identified discipline of GST we will still adhere to the latter for the very reason this paper addresses a society of not so familiar to computer science. As a base for discussions some modelling approaches are presented and we will find out that these approaches very soon fade out into an overwhelming complexity that possibly could be handled straightforwardly or mathematically. In other words they call for other methods of approach – that is computer simulation.
2. THE NETWORKS APPROACH.

When trying to characterize the mechanisms of phenomena observed in the real world, there are many terms to use or misuse; network, system, organization, complexity, collection, organism, aggregate, pattern, structure, etc.

The term network has become a fashion word often used when describing interconnected phenomena encountered in the real world. The term itself is not new and the concept of a network has had a conspicuous place in such diverse fields like communication, psychology, sociology, biology, system science, mathematics et cetera. It is used to describe an openwork fabric or structure in which a rope, a thread, or wires cross at regular intervals. Typically, such a metaphorical construct is used about something resembling a net thus compromising many parts, passages, lines, or routes that cross, branch out, or interconnect, for instance a telecommunication network, a traffic system and so on. A group or system of electric components and connecting circuitry designed to function in a specific manner is also called a network. Seemingly this stands for a net-like pattern of connection among different items or elements found in some particular universe of discourse.

Such a pattern of connection is sometimes called an organization, but the usual meaning of this particular term is to point out something else; That the phenomenon in question has been organized (or ordered), i.e., conceptually gathered to an ordered whole or something comprising elements with varied functions, which contribute to the whole and to a collective function. Very often the elements of the organization are thought of as having some specific responsibility and/or united for particular a purpose. Fishing net is the prototype of a network, for sure, but no one ever thinks about such a net as an organization. An organization is better thought of as a pattern of connection between certain elements that together display a coordinated behaviour; i.e., an organism. This remark reveals the dynamic connotation of the term organization.

When turning to the non-life sciences like physics and chemistry the use of the term network, is not so frequent. These sciences describe the structure of matter in quite other terms. Elements gathered into a collection or sum that constitutes a whole (or a total) is named an aggregate. We think of aggregates as lacking of internal structure, that is, an entity lacking a principle of organization or specified inter-relation of elements. We say that in a gas the molecules are gathered into an aggregate and sand occurs in heaps in a more or less chaotic way. This lack of organization is most of all meant to specify that the individuals are interchangeable and that there is no need for tracing the individuals.

In these sciences there is also a need for grouping elements into interacting or interrelated complex wholes. The pattern of connection between atoms and molecules has always been the area of main interest in these sciences. The planet system analogy reveals that the terminology of systems thinking is use here and gravitational forces model interaction. These wholes then compromise abstract constructs - we call them systems - but we often fail to emphasize this very act of abstraction. That is, we regularly fail to underline that both the system and its properties rise in the mind of some system viewer (observer) only and thus not at all compromises anything intrinsically defined nor anything else that can be attributed with some self-evidence drawn from some presumed real world.

The observer in question always defines any system, its parts, boundaries and properties – this is the lesson learnt from GST. However the natural scientist, caught by his paradigm, most often fail to recognize this necessity.

I will soon come back to this important subject, but in order to give a concrete meaning to the account mentioned and emphasize how modelling efforts could also be used to enhance conceptual clarity and consensus within a scientific discipline we will briefly touch upon that subject matter as brought up in a study of the conceptual framework used within the Swedish Network Approach in industrial business marketing. This choice is motivated by the international reputation and importance this school enjoys and the fact that they are the pioneers of the network idea in business marketing. The
ideas of this school have lasted for a long time and given rise to new and fruitful view of industrial business marketing.

In spite of that the Swedish Network Approach in many respects represents the situation normally encountered within today’s social sciences. The lack of a working paradigm is total and sometimes stands out as embarrassing. The lack of basic assumptions, conceptual clarity and established methodology within the diverse disciplines of social science is a severe hindrance, not only to interdisciplinary modelling attempts, but also to inter-subjective communication within the discipline itself most often resulting in unproductive and interminable wrangle. The possibility of becoming more "experimental" in the sense of extending the arsenal of research tools by the additions of the experimental technique of computer simulation is drastically reduced by this urgent need of explicit paradigms.

3. THE SWEDISH NETWORK TRADITION IN INDUSTRIAL BUSINESS MARKETING.

The mathematical formalism is not a feasible starting point for modelling efforts within the neither social sciences nor industrial business marketing, but so is the terminology of object-oriented programming.

The network approach, a base for many Swedish marketing researchers since the 1980s, is by now so firmly established that one could talk about the evolution of a research tradition. This tradition in the industrial business marketing emerged from many empirical studies on business relations between industrial supplies and customers. K. Moller [Mol93] has given a description what industrial business marketing stands for:

Marketing is about understanding, creating and managing exchange relationships between economic parties: manufacturers, service providers, various channel members, and final consumers. Inter-organizational business exchange takes place between organizations and their representatives. Its forms range from single transactions to complex long-term relationships.

The Swedish Network Approach (SNA) draws from many sources, most pronounced from the theory of social networks, but as already pointed out, viewed as a general scientific approach the networks (or systems) view is widespread and basic to all disciplines of science and seemingly offers nothing new. A conclusion is then that SNA, to have the significance apparently shown, must lay out an important foundation for discussing and modelling the industrial business marketing; that is, to identify the elements, subsystems and system dealt with in marketing and interrelations among these, also outlining the dynamical behaviour displayed by this process.

A survey of papers presenting the ideas of SNA exhibits the use of a multi-faceted conceptual vocabulary on which ground many modelling efforts could be severely hampered. Modelling is a process very useful as a first step doing predictions but also very useful when trying to understand phenomena and laying out a conceptual framework. There is presumably no need to establish computational models to serve as base for predictions, but instead a conceptual model to serve as a base for discussions and demonstration of the mechanism involved in industrial business marketing. Such a conceptual model could serve as a base for discussing what industrial business marketing means, why it is important and how the mechanisms of this special market work.

The empirical studies, earlier mentioned, on business relations between industrial suppliers and customers have indeed shown the inherent potential of the Swedish Network Approach in that respect. The survey of papers presenting the ideas of Swedish Network Approach [For86, Gad87, Hak92, Hak93, HHj93, HHO75, HJJ80, Sne93] exhibit phenomena extending from dyadic business relations to complex networks of international business, most of which is laid out verbally and in bushy phrases. This situation is unsatisfactory, but must not necessarily be interpreted as a lack of consistency or a sign of weak foundations. This situation often emerges when researchers, in lack of a suitable conceptual language within their own discipline of science, try to explicate novel ideas. The very first

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step is, most often, that we in the efforts to present the main ideas involved, most frequently use ill-defined concepts and invent buzzwords to explain or sometimes enhance the ideas involved. Often we also use concepts, not very well understood and/or even borrowed from other disciplines of science, and by that move create an interdisciplinary confusion that most often are very harmful.

This use of a language could not possibly be a good base for efforts trying to develop frameworks for modelling and industrial business marketing is no exception, concepts like system, network, model, actor, entity etc. is often used with vagueness or without any definition whatsoever and this creates massive confusion. We must understand and submit to that all our theories and conclusion stands or falls with the clarity of the professional languages we use. So do our ability to communicate within the scientific community as a whole, and the rest of the world as well. We therefore have to intensify our efforts to clarify the terminology.

One thing is for sure, when modelling the industrial business marketing - or any other scientific discipline for that matter - we cannot do without a powerful conceptual language and most important to achieve is a certain level of a consensus and a firm base to discuss phenomena encountered, mechanisms involved and various modelling efforts. There is a need of an explicit paradigm – at least provisional – where at least the base assumptions and the concepts in use are clearly specified. What distinguishes science from non-science, according to T. Kuhn [Kuh62], is the existence of a paradigm. In the same vein we can spell out the same difference between rational and irrational human activity. Many a social science lacks of a paradigm, which bring down defame – SNA does not lack of implicit paradigm – however it must be brought out in the open and to become common property for the sake of both disciplinary and interdisciplinary understanding.

4. COMPUTER EXPERIMENTS AND DISCRETE-EVENT SIMULATION.

Social science is certainly not an area well suited for experimentation, but computer experimentation and simulation offer a negotiable way to become experimental.

The essence in the SNA is not likely to come without efforts to develop also a modelling framework closely tied to the professional language of marketing used in industrial business marketing. The inherent complexity exhibits by the model-mechanisms of industrial business marketing and the multitude of phenomena encountered in this area also a recommends a use of a different modelling approach but the strictly mathematical. This observation and recommendation is applicable to many disciplines and as the case is for computer science there is no longer a need for using mathematical models also in the social sciences even as an intermediate stage when modelling. The mathematical formalism was imposed by the tools our ancestors had in hand during the seventeen hundred centuries, the paper and pencil. Today's tools are computers and the graphical facilities offered here are dynamic, coloured three-dimensional pictures displayed on the computer's screen.

We for sure need mathematics to calculate the display coordinates on the computer screen, but there is no need for it any longer for the sake of modelling a social society. There is a lot of easy-to-understand program ware available for that purpose on the market. When approaching this methodology the experimental technique of simulation will be available also to the researchers and teachers in the social sciences that very well could benefit from using an experimental technique and visual demonstration facilities. In the case with SNA the need is even more urgent, because in industrial business marketing one can only perform experiments by means of models. In conclusion, there is a need to develop the conceptual framework of industrial business marketing, and those of other disciplines, in such directions that it could be used in also an integrated effort developing models for use in computer simulation. Such a framework could appeal from being guided by the worldview of object-oriented modelling, an approach very useful when trying to keep up the intuitive ease.

Simulations experiments take advantage of the fact that scientific laws can be stated as algorithms, or procedures, and by doing so we find how different systems behave. The computer program is one medium in which these algorithms normally are expressed. Physical or abstract objects and structures can be represented as numbers and other symbols in a computer, and programs are written to manipulate them according to the appropriate algorithms. When the computer experiment later is performed by executing the programs written, it thus causes the numbers and symbols to be modified.
in the way specified by the scientific laws and the consequences can be deduced. Executing a computer program in this way is much like performing an experiment. The laws of nature though do not bind the objects in a computer experiment. Instead they follow the laws embodied in the computer program, which can be of any feasible form. Computation thus could be used to extend the sphere of experimental science as it allows experiments to be done in an abstract universe.

Scientific laws have conventionally been constructed in terms of a particular set of mathematical functions and constructs, and they have often been developed as much for their mathematical simplicity as for their capacity to model the salient features of a phenomenon. A scientific law specified by an algorithm, however, can have any form and in this way computation also extends theoretical science. The study of many complex systems, which have resisted analysis by traditional mathematical methods, is thus made possible through computer experiments and computer models. Computation is emerging as a major approach to science, supplementing the long-standing methodologies of theory and experiment, also extending the possibilities to make use of an experimental methodology in the social sciences. Considering the complexity found in industrial business marketing we realize that the mere uses of mathematical analysis and modelling is not sufficient and probably not even feasible. This paper is much devoted to the task of placing industrial business marketing on a scale of complexity and discusses some modelling approaches possible and the methodology of computer experimentation or simulation indeed offers a negotiable way, most likely the only one.

Discrete-event simulation views a model as a structured collection of entities where the various entities interact through simulated time. To build a model suitable for discrete event simulation it is necessary to:

- Identify the important classes of entities
- Consider the activities in which they take on
- To link these activities together

In discrete-event simulation a model usually moves through time by moving from event to event. Event-driven models assume that nothing relevantly happens between successive events (state transitions). An event is considered to change instantaneously the state of a model. The state of a model can be represented by the set of the values of its state variables. An event changes the values of the state variables and/or can schedule new or cancels previously scheduled events. There are two types of events: unconditional and conditional. An unconditional event depends only on its scheduled time and occurs when it is scheduled. A conditional event depends on the values of the state variables and may depend on time as well. It occurs when its condition is satisfied. There is several sequencing strategies used by model monitors and they all depend on the way descriptions of the model behaviour are modularised. There are at least three widely used approaches to modelling for discrete event simulation. These are:

- The event approach
- The activity approach
- The process approach

Each approach has a different way to organize the time dependent behaviour of a discrete-event simulation model. These three world views differ in the way, which events are scheduled in the future and the ways, which the routines are grouped together, but they can all be derived from the same real world view, which one to choose, is highly dependent on the system view of the observer. The object-oriented simulation approach to real world modelling and the possibility to modular build-up of simulation’s programs is a very attractive feature when handling a complex problem. To clearly see that so is the case, we first have to explore the concept of complexity in more detail.
5. **WHAT IS COMPLEXITY?**

Complexity has many facets; simple phenomena could show complex behaviour and complex phenomena could be treated in a simple way. Things hard to understand we consider complex and we have a predilection for dealing with simple phenomena.

Complexity is an idea that we recognize as an annoying part of our everyday experience. The problems we try to solve often involve elements of inescapable complexity, in which we find unbounded interrelations and competing behaviour. Consider the intrinsic complexity of a computer system, a car, a business organization or a human being. A child learning to read, the composition of the human body, the behaviour of the molecules in a glass of water, these are but a few of the phenomena in the physical world that involve truly some stunning complexity. We encounter it in some diverse contexts and commonly we get the feeling that complexity is related to different facets of life and especially when it comes to explaining the mystery of life the complexity starts to build up.

Living organisms are thought of as exceptionally complex and this complexity could be seen as twofold. The *structure* is normally very complex and so is the *behaviour* of the organism. Complexity is normally attributed a phenomenon with a complicated composite structure, but quite as often this term is meant to mirror the fact that a phenomenon is unpredictable or badly understood. There is really no need to look for just structural phenomena to exemplify complexity; just tossing a coin is a process of considerable complexity. Here the term complexity reflects or inability to mathematically handle the outcome of such a relatively well-understood phenomenon.

Many problems dealt with in scientific textbooks are fundamentally simple but this fact does not at all reflect that reality is simple or uncomplicated. This is merely a consequence of our ability to concentrate on phenomena that can be described in terms of simple laws, rendering simple and computable algorithms, which could be used to make predictions about the future. Often the simplicity is apparent because we concentrate on just an object and we think of very few actions as involved. We could also simplify extremely by just modelling the behaviour during a short time. We can predict the falling of Newton’s famous apple just for a couple of seconds. What is has happened before the actual falling starts and what is going to happen when the apple hits the ground are processes too complicated and complex to be described by means of lawful models. Verbal models could just as well describe these processes, unfortunately then of little use when trying to do predictions. When we think of phenomena like economic systems, languages or the human brain the complexity is attributed these phenomena partly, because there are many interacting elements involved, but also, because of the fact that the processes involved are not fully understood.

Complexity has two important facets, the *structural* and *behavioural complexity*. Some years ago we thought these facets were highly correlated. This is not so, the theory of chaotic systems clearly shows that structurally very simple systems can display complex behaviours. On the other hand statistical thermodynamics shows that a complex behaviour sometimes can be described in very simple terms. Many parts, or elements, or components that could be of the same or of different kind characterize structural complexity. The elements could be connected in more or less a complicated fashion. Some disciplines of science offer us fairly simple systems whereas others may truly be called complex. In physics we often deal with particles, gases and crystals that are comparable simple system. In chemistry the complexity grows and biology abounds with complex systems. In a cell some thousand metabolic processes may go on simultaneously. Animals form animal societies. In the engineering sciences machines are found, also computers and telecommunication networks. Economy with its many participants, its flow of goods and money, production, consumption provides us with another example of complexity. The human society with its various activities is for sure a very complex system.
6. HOW TO DEAL WITH COMPLEX SYSTEMS.

We abstract, we simplify, idealize and restrict the area of interest. Data are reduced, compressed and mathematically manipulated. To handle the problem we split observed phenomena into the categories of static and dynamic.

Since complex systems are so widespread, we must find unifying principles for dealing with such systems. To describe a system at a microscopic level, we need an immense amount of data that eventually nobody could handle. We have to introduce some sort of economy of data collection and ways of reducing the amount of data found in the real world. The discovery of common abstractions and general mechanisms is helpful for the understanding of complex systems. We also reduce substantially the amount of data involved and carry out extensive simplifications to aid this process of understanding. The information collected by perceiving and the rules or laws stated by this process of understanding, we denote knowledge of the phenomenon and this knowledge is an aid to handle the phenomenon dealt with. It is important to emphasize that we have already encountered a first point of the organization of knowledge, as we by using the word phenomenon implicitly appoint something concrete or abstract in the universe to be the "object of interest." After identifying the phenomenon we realize that to handle it a primary requisite is that it is familiar to us, that is, we have some sort of experience from it, which is the way it appears or behave. This means that we have an internal mental representation of the phenomenon in question. Here is the second point of organization, when we make a clear distinction as to appearance and behaviour. Often we assign a certain physical appearance and some inner structure that are fairly stable to the phenomenon of interest and we also have an approximate idea of its behaviour throughout time. Logically we often separate these two representations as to the static structure and the dynamic behaviour of the phenomenon. This separation is probably rooted in our habit classifying the world in terms of space and time. The mental representation of the phenomenon is the basis for our ability to handle it. We use the mental representation when communicating verbally about the phenomenon and when laying out models. We use this mental representation when making predictions and in efforts controlling the behaviour of it. Recently scientists have been aware of that we depend on this mental representation also when perceiving the phenomenon. The mental representation is the human scientific way to organize knowledge about the world and we have already seen two aspects of this way of organization: When appointing an area of interest and using the dichotomy structure and behaviour. This dichotomy is a very important one since it could be seen as the cause of two different ways of approaching real world modelling; The traditional functional approach (popular between technologists) and the object-oriented approach. This dichotomy is also very useful when trying to sort out intermingled concepts. That is, a real world phenomenon could be thought of as recorded on a roll of film to be used in a movie, each frame representing a transient picture of a static structure, together defining the dynamic behaviour of the phenomenon as the movie is shown on the screen. Further on we will use this dichotomy structural/behavioural or equivalently static/dynamic.

There is also another, even more an important facet to complexity, in that way it reflects our inability to mathematically handle systems outside the realm of physics, that is, fairly simple systems. Even the idealized three-body problem, once the item of study for Poincaré, exhibits a complex behaviour approaching the limits of our ability to handle the problems mathematically. The limits of physics are not just only the very little and the extremely huge, like the universe, but also the very complex. One successful method of Western science is the analytical. By decomposing a system into its part we try to understand the properties of the whole system. By doing so we really infer microscopic events from macroscopic data utilizing an extreme form of reductionism. We could ask the question (which is seldom done) whether different microscopic models could lead to the same macroscopic set of data. Reductionism also has its own obvious limitation, in that way we cannot explain life by means of physics or chemistry. When we proceed from the microscopic to the macroscopic level, many new qualities of a system emerge, which are not present at the microscopic level. Inherent in this
proceeding is also an enormous compression of data, which has to be performed just to handle the situation. This is also a facet of complexity.

7. INTERNET AND BUSINESS MARKETING - A NETWORK OR A NET-LIKE ORGANISM?

Maybe there is a better metaphor but the network to use to characterize certain classes of systems?

To gather up the strands, we recollect that the phenomenon of interest for industrial business marketing and our investigation is a collection of elements or objects that are seen, studied and kept together in a certain way. The elements of this collection are interacting and interrelated forming a whole that means that we are dealing with a system. We are interested in the structure of the system, that is, in the way that the elements are arranged or held together. Seemingly this structure is complex, complicated, intricate or involved. These adjectives describe things having parts so interconnected as to make the whole difficult to understand. Complex and complicated are similar in showing a challenge to the mind. Complex, however, often implies many varying parts; complicated stresses elaborate relationship of parts rather than number. Intricate refers to a pattern of intertwining parts that is difficult to follow. Involved stresses confusion arising from the commingling of parts and the consequent difficulty of separating them. Structure implies a condition of methodical or comprehensible arrangement among the separate elements we say they are ordered to make a distinction from a disordered arrangement.

When we turn to the behaviour the system could also be classified in terms of order and disorder, but we prefer to speak about deterministic and chaotic behaviour. We are also able to recognize organizations; both at the system and subsystem levels, and a certain purpose could often be attributed to these systems. Thus, here the whole system looks like and behaves like a gigantic organism. To mirror the boundlessness and the net-like interconnectedness of such complex a system the term network could be appropriate, but we must take care so that this metaphoric paraphrase is not taken literally. As pointed out the term network is used to describe an openwork fabric or structure in which rope, thread, or wires cross at regular intervals. That is, using this idea we are looking for a well-defined, regular pattern with visible or at least graphically presentable links. Intuitively this idea does not very well reflect the mechanisms involved in organizations. Here we find subjectively undefined links invisible to the external world, a dynamically elastic pattern of connection and actors intended and goal seeking. This certainly suggests the metaphoric use of a more organic dynamic structure to visualize the concept of a dynamic organization - namely a gigantic amoeba. Multinational corporations and the Internet are striking examples and this observation reveals an obvious link to the science of artificial life.

8. STRUCTURE AND ABSTRACT DATA TYPES.

There is a need to clarify the structural aspects of the industrial business marketing network idea, but first we have to dwell on some concepts useful in classifying structures and how structures could be manipulated computationally.

Computer science is the study of information processing, how it could be manipulated and utilized. Unfortunately, the concept of information could not be defined precisely, but for our sake it is sufficient to realize that information about real world phenomena is represented by means of data. The basic unit of information is the "bit," whose value asserts one of two mutually exclusive possibilities. When we are dealing with phenomena that could take on more than two states, we can by using the binary alphabet, the digits 0 and 1, represent any state by a finite representation as a bit pattern 00010001110000111. However there is nothing about these bit settings that intrinsically implies that a particular setting represents a particular set of information. In fact the bit pattern might represent nothing else but itself. If and how this bit pattern represents some sort of information is
solely up to the receiver of this bit pattern (or a datum). We must not even think of data as representing information just numerically, by means of coding any message or any sentence in any language, natural or logical, could be expressed as a binary pattern. That is, the distinction in terms of mathematical and verbal models is surely not a matter of form.

That is, we see that the data itself has no meaning. Any meaning can be assigned to a particular bit pattern, since it is done consistently. It is the interpretation of a bit pattern that gives it meaning. A method of interpreting a bit pattern is often called a data type. We know about many data types like integer numbers, real numbers, characters, string etc. Since we are only interested in the logical properties of a data type we restrict ourselves to present a collection of abstract data types. This term refers to a mathematical concept that defines the data type and its properties from a functional point of view. Fundamentally, an abstract data type is a collection of values and a set of operations on those values. That collection and those operations form a mathematical construct that may be implemented using particular hardware or software data structure. That is, the computer or software used and the specific implementations or aspects of time or space efficiency are of no interest.

Most algorithms operate on simple data types like: pointers, integers, reals, characters, or strings of characters. By building more complex data types from these elementary building blocks we create abstract data types capable of organizing the information in different ways. To every abstract data type there is associated a particular set of operations, for instance to the integer type of data, we normally associate the operations of addition, subtraction, multiplication, division etc. When it comes to the more complex abstract data types like lists and trees, we also associate certain operations, to act upon these abstract data types, for instance insertion, deletion, concatenation etc. The more complex abstract data types include pointers and the purpose of those pointers is to maintain a particular the order between the elements. These pointers are thus a part of the orderly structure and are used, for instance, when navigating among the elements. From the information point of view a pointer structure could be thought of as ordered or not, but the very purpose of pointers are keeping the elements together as a group in the computer address space. This could in fact be the sole purpose of the pointers, but often, from the modeller’s point of view, they also represent some sort of inter-elemental exchange in terms of material, information, energy, etc.

Thus have the simple abstract data types and the more composite abstract data types (i.e., array and list) and these are part of the vocabulary and the structural and algorithmic knowledge of computer science. This is a core of manipulating we cannot do without, when laying out new approaches of computational modelling. Before doing so let us review the structural aspects of mentioned abstract data types in the light of the Swedish Network Approach.

9. **THE SYSTEM UNDER CONSIDERATION - THE NETWORK.**

The observer defines the system, which is an abstraction, and he also defines the rules of connection between the elements.

A system is always an abstraction formed in the mind of the human being observing a specific phenomenon (the real world domain) of the real world. This real world phenomenon could be real or abstract, but the observer must always point out his view of the area of interest or the domain of investigation by means of using an apprehensible border or stating a specific rule. To be unambiguous this specification must be done so that it can be uniquely decided if any phenomenon belongs to a certain real world domain or not. This is the first step to reduce the complexity of the world or equivalently introduce some order into the world. Thus, by specifying the real world domain the observer charges the world by order, that is, he groups the interesting phenomena together by means of a border or a rule. This observation reveals that we can look upon order the same way we look upon beauty; namely that order and disorder are in the eye of the beholder.
Using the notions of the set theory:

\[ B = \{ \text{all brown horses} \} \]

\[ C = \{ 2, a, 6, 7, \# \} \]

A, B and C now define set containing certain elements. By doing so we draw an invisible, imaginary border in the real world. If all the elements in this system domain are abstract, which is conceptual, we can state our definitions and play a scientific game according to invented rules without regards to the real world. We can name this game logic, semantics, mathematics, or anything else. When there are physically concrete elements in the area of interest have to map the real world domain into an image world domain to specify what aspects of these worldly elements found we are interested in. By doing so we can handle all objects of interest in the world, abstract or real, as belonging to the same image world domain. All our constructs by definition belong to this domain. These ideas are developed in detail in "An Intuitive Approach to Modelling" [Kje94].

The abstract data type named SET is a collection of disordered elements. When we allow duplicates to be found in the SET we generalize the SET into an abstract data type of a BAG. This use of the term "disorder" means that the observer does not imply any order upon the individual elements and they are said to be aggregated. In spite of that, there is an implicit "order" to be found, as we are able to recognize: the SET and the remaining world. The border or the rule of selection maintains this "order", which divide the world into the system and the environment domain. Using the computer programming language C++ this abstract data type could be defined as:

```cpp
struct Set {
    void* data;
};
```

Applying this outlook of a real world phenomenon the environment domain is often pictured like one area surrounding another:
When using a block diagram, we could easily line out the situation when the environment domain is thought of influencing the elements of the system domain:

Suppose now that the observer presupposes a certain order among the elements, this means that the elements are thought of as related in one way or another. For instance, there could be a *temporal order* between the elements and then this is the system view of the domain of interest.

Such a way to arrange data is called a LIST and the finite set of elements is now thought of as organized *sequentially*. The LIST could be arranged circularly and thought of as *directed or undirected*. We observe that we can remove the border, because the elements are now "kept together" by the links of the elements, which also defines the predecessor and successor of every element.

```c
struct elem {
    void* data;
    elem* prev;
    elem* next;
};
```

In this abstract data type we use pointers to point out the predecessor and successor of every element. This abstract data type is called a LIST and this is a *finite linear order* that could be defined as:

Removing the pointer *prev* of the structure make the LIST *directed* and we must make it circular to be able to access all the elements of the LIST from one pointer.
Removing the pointer to the data of the LIST we obtain the *pure structure*:

```c
struct elem {
    void* data;
    elem* next;
};
```

10. THE ORDERED TREE AND THE GRAPH STRUCTURES.

The list structures are easily expanded to the tree and graph structures that seemingly have a structure more truly reflecting the ideas found in the industrial business marketing.

The types we have discussed until now is inherently one-dimensional. That is, one element follows the other. We now consider two-dimensional linked data types called trees used, for instance when keeping track of ancestors and/or descendants with a family tree. A tree is a nonempty collection of nodes and edges that satisfies certain requirements.

```c
struct node{
    void* data;
    node* parent;
    node* l_child;
    node* r_child;
};
```

The tree has two directions, up down and left right, but often the pointer to the parent is missing because there is often no need to traverse the tree from bottom up to the root. Dealing with business organizations we often meet with the *general ordered tree*, in which each node might require any number of links to the nodes below. An ordered tree could as well be seen as a *hierarchical list of lists* and the organization chart is a typical example.

Great many problems are naturally formulated in terms of elements and connections between them. For example given an airline route map of Sweden we might be interested in questions like: Which is the fastest way from Sundsvall to Malmoe? We might be more interested in money than in time, and look for the cheapest way. To answer such questions we need only information about the
interconnections between elements. Another example is job scheduling, where the elements are tasks to be done, say in a manufacturing process, and interconnections show which jobs should be performed before others. A graph is a mathematical object that accurately models such situations. Graph theory is a major branch of mathematics and has been studied intensively for a hundred of years.

The simplest type of a graph is called an undirected graph. In weighted graphs integers (weights) are assigned to each edge to represent, say, distances or costs. In directed graphs, edges are one-way: an edge may go from x to y but not from y to x. Directed weighted graphs are sometimes called networks and they are useful for modelling several types of applications involving commodities flowing through an interconnected network. Consider for example, a network of oil pipes of varying size, interconnected in complex ways, with switches controlling the direction of flow at junctions. Suppose that the network has a single source, an oil field, and a single destination, a refinery to which all the pipes ultimately connect. This networks flow problem in a non-trivial one to solve. Such a general set-up can be used to describe traffic flowing along highways, material flowing thorough factories, etc. This type of problem lies at the interface of computer science and the fields of operations research. Very often it is possible to develop a precise mathematical formulation that captures the interaction involved and reduces the problem here to a purer mathematical problem.

In short, there is a wide spectrum of problems and algorithms for dealing with graphs. There are many interesting and useful algorithms developed largely aimed at deciding the connective properties of both undirected and directed graphs. Some algorithms are very efficient and many interesting problems have been studied for which good algorithms have not yet been found. Some graph problems that arise naturally and are easy to state, are quite difficult to solve and no good algorithms are known to solve them. For instance, the travelling salesman problem, which is finding the minimum cost tour that visit each node in a weighted graph, belongs to a large class of difficult problems that are said to be NP-complete and the theory of NP-completeness shows that we still have a great deal to learn when trying to solve problems.

When complexity grows, a situation that will turn up very soon, the problem to mathematically state and solve the model becomes increasingly complicated, not to say impossible. We must not think that a solution to this dilemma is always to be found by the use of super-computers, because the situation arisen many times really calls for another modelling approach; simulation. Fortunately this approach at the same time also offers social science an opportunity to keep away from heavy mathematical modelling. We must realize that this does not mean that we can keep away from modelling. The difference is that conceptual modelling take the place of mathematical modelling. This could be the point of a dawning shift of a paradigm; conceptual modelling and dynamical simulation’s experiments will supersede mathematical modelling and analytical solutions as a tool explaining phenomena of the real world. To indicate the path to follow we will once more briefly touch upon the industrial business marketing network as a representative of many complex systems.
After this excursion in the terrains of computer science and operations research we have a base to discuss the industrial business marketing network both from a modelling conceptual perspective as a computational one. The survey of papers presenting the ideas of Swedish Network Approach reveals that the notion of a network is used with different a signification. First we observe the use of the network as a metaphor, merely saying that industrial business marketing could be visualized in terms of a network of related nodes very much like a telecommunication network. Secondly we must note its role as indicating a new era in industrial business marketing [Sne93] "The notion of markets being network entails a radically different perspective on the nature and working of the market process and therefore on the market behaviour of a business perspective" and, as mentioned, new eras are often highlighted by the invention of a notion. The new arisen interest in complexity is another example as it reveals a deepened interest in complex dynamic systems, but complexity is nothing new. Thirdly, as different authors lay out the network ideas, apparently not always in concordance, there are really great difficulties when it comes to understand and coordinate the underlying basic ideas. Thus, we must approach the phenomena encountered within IM very cautiously and in a more systematic way but normally found We must be carefully when introducing or redefining terms and be watchful on the resolving power of description. The IM community must of course mainly undertake this discussion but in order to resume, we will approach different aspects of the industrial business marketing separate the phenomena in terms of mainly static and dynamic phenomena. Discussing abstract data types above we saw that every abstract data type is defined by means of its data structure and a set of operations. Concentrating on the data structure, we could see the build up of a network as a set of elements interrelated to each other by means of pointers. These pointers are used to make the structure orderly, the concept of which could reflect an intrinsic order from the perspective of modelling or just span up a space of addresses for the sole purpose of navigating among the elements. Next we could ask what are the elements of this abstract data type? We might find the answer in the industrial business-marketing concept of an actor. This answer reveals an interchange in terminology; the "elements" of set theory has turned into the "actors" of industrial business marketing. First let us try to catch the actor concept as use in IM. [Sne93] "A business enterprise in a market is a component of a network organization." Obviously there is a network, thought of as made up by business enterprises as elements. Turning to other researchers, this idea is seemingly a bit narrow; [HJJ93] "We consider the actor a theoretical construct in the sense that the specific actor or actors in a network can be an individual, a department in a company, a business unit in a company, a whole company, or even groups of companies. We do, however, assume that all industrial actors share basic properties." This assertion could mean that we are not speaking of one network; instead we are speaking of several intertwined networks forming more a gigantic super-network. Individuals in a network form departments or business units, departments forming companies, companies forming groups and all these sub-networks forming a super-network. What is then the interpretation of this super-network? Is it all industrial actors to find in the world, in the "market" or in a specific branch of the market? If we are talking about a specific branch of the market, how is this branch then related to other branches? One way out of this growing dilemma is to define industrial actors independent of notions like individuals, departments, business units, companies or groups of companies, that is, to wipe away the company borders and anchor the nodes of the network in the actor concept. Another way is to try to handle the enormous complexity rising by defining a network of networks. Not being able to come to a consensus when identifying the elements (nodes) of the network will of course lay waste all attempts of modelling the industrial business marketing network phenomenon. We postulate that an actor is a business enterprise and that we are dealing with a network of business enterprises. This might not be a wise choice but we have to do something to be able to continue the discussion commenced. Let us look at some of the properties of the actors. The elements (actors) of the network are all different, but they must be treated as individuals. We guess that is the essence of a sentence like [Sne93] "Network organizations are organizations of heterogeneity. It has no other purpose except possibly the enhancement of the heterogeneity itself. The heterogeneity in capacities of the actors (the complementary) underlies the process of self-organizing. It is a condition for exchange and therefore for the interlocking of activities of its components. Pursuit of heterogeneity and differentiation in capacities is both the result and driving force of the network organization." Simultaneously they obviously have the
same basic properties, [HJJ93] "we do, however, assume that all industrial actors share basic properties," a state of affairs a bit confusing, which nevertheless could be handled from a modelling perspective.

The next question is what are the bonds between the elements? The pointers define an address space, that is, given a certain enterprise we could use the pointers to navigate among its associates. In the industrial business marketing network the pointers also have another function; Defining a relation of exchange. [HJJ93] "The exchange relations between actors are basic elements in industrial networks. It is assumed that the exchange is a network necessity, which furthermore influences the individual actor's perception of its own interests. For this reason, and because of the basic properties of the actors, the exchange has not only an economic dimension but also knowledge and value dimensions." Thus, the inter-elemental bonds are twofold both structural and defining exchange of goods and knowledge. In the object-oriented framework the pointers define the structural bonds and the exchange characteristics are modelled by means of functions (methods), belonging to the description of respective actor. The content and parameters of these functions are very easily changed and the exchange activities could accomplish message passing between the actors.

Finally, the question about the structural extension of the network and here we meet a feature that is strikingly highlighted by using the notion of a network; Namely the boundlessness of industrial business marketing. [Sne93] "Admitting that in a market's set of actors is tied together by distinct and continuous relationships with a limited number of counterparts leads to a picture of a market as an endless net of relationships connecting market participants". Using the idea of an international network we supersede the idea of national borders and geographically oriented markets. By introducing the amoebae metaphor we also make clear the property of an ever changing, evolving intertwined network, out of reach of detailed specification, just leaving the immediate local environment open for a worldly definition. The Internet communication network is a striking parallel phenomenon. So much for the structural properties of the industrial business marketing network and with these approximate conceptual knowledge in hand let me sketch one possible approach to modelling the amoebae of industrial business marketing.

12. USING A TREE-LIKE MODEL FOR THE INDUSTRIAL BUSINESS MARKETING NETWORK.

Concentrating on a characteristic given by Jan Johansson "an exchange network is a structure a company conceives as the relationship network it is involved in" and the definition given above by Snehota we could easily identify an ordered tree. This tree-structure is well known, and it is just a matter of defining the nodes, describing the edges and assigning relevance to the bindings.

Introducing other companies, we realize it might be wiser to extend the network architecture in a third dimension, instead of adding more edges forming an intricate web of this originally simple two-dimensional tree.
In this way we create a gigantic cluster, like an amoebae, which could be used to describe the industrial business marketing mechanisms within a specific branch of marketing. The point is, by extending the model in many layers (or levels) we keep the original outlook of a network basically made up by interacting companies and in this way we keep the intuitive ease to interpret the model. It might be possible to handle the relations of a company in such a model, perhaps also that of a company’s or a whole branch of business relations. Extending the networks these steps further, make us understand that complexity rapidly builds up and the possibilities to get a solution from a computational perspective based on deterministic assumptions is out of the question. This might not even be a hindrance, as we also start to realize that strategic decisions on a company level are practically ineffective when it comes to estimations of the total behaviour of the network. Such questions might lose in value because no answer could ever be given. It might be wiser to reformulate the question into: Considering such an organism-like network, what types of strategic decisions have the possibilities to effect behaviour of the network? What strategies of survival are the most probable to survive? We have to move from a semi-microscopic view of the company to a macroscopic view of the market.

In order to keep the intuitive flavour of the modelling approach we also have to consolidate this semi-microscopic view of the company by connect with its individual actors and the resources in his possession. By that, the next question is what are the relations between different actors within a company? We must then probably form another network, possibly more intricate or more decentralized but the industrial business marketing network what concerns the cross-connections.
Then we have another "internal" dimension affecting the behaviour of the company in the network. It might also turn out that are more fruitful approaches to the network concept is to regard the individual actors as nodal element of a business marketing network and fade out the importance of the company as mentioned before. The activities of the actors are of course defined by their behaviour and knowledge but how could we link the actor and his limitations as it comes to resources? One way is to handle the resources of an actor is to regard the resources as a sub-network at his disposal. Money, goods, knowledge, business relations, investments becomes a sub-network supporting and delimiting the activity of the individual actor. The nodes if this sub-network is for certain interrelated with other the networks and by now we are losing the trails and the set of possible networks seems to intermingle into a chaotic mess. This insight is the clue to the idea of wiping out the company borders when it comes to modelling the *industrial business-marketing* network anyhow.

It is difficult to at this point develop the possibilities to numerically handle such a model by means of a computer. The complexity encountered convinces us that this must for certain be done by means of simulation. The possibilities to handle a model that complex by means of some sort of numerical algorithms are insurmountable and were they not, the impossibilities of defining reliable quantitative measures would lay waste to such attempts anyhow. Turning to the simulation aspects we could ask the question, if the degrees of freedom and the amount of connection in such a model is so many that every modelling efforts also turn out into chaos? For sure some system will behave like *dynamic system exhibiting chaotic behaviour* and we then could at best hopefully find patterns that usually characterizes chaotic systems like self-similarity and fractal patterns.

On could ask the question whether such a model is realistic? The way we have modelled the industrial business-marketing world hopefully gives us the opportunity to identify some mechanisms found there. On the other hand the answer could as well be no, because this type of model is not reality meant to portray reality (be realistic), but sooner to give a frame of reference to keep different theories together. In the same way as Bohr’s atomic models of serve as a frame of reference for explaining the behaviour of the atom by means of a very manifest picture (which in a sense could not possibly be true), just serve as a frame of reference for our knowledge. In a similar way some layered network models of business marketing could serve the same purpose. The question of how to identify observed real world phenomena from details in the behaviour of the model is nonsensical, quite as nonsensical as any speculations about the nature of the forces affecting the nodes as the questions about the force fields surrounding the objects of this model. We think it is in vain top develop such a model according to physical ideals. We think it is in vain to even wish to meet analogies that could have a sensible real world interpretation. Now turning to the dynamic aspects if IM we have to introduce some concepts most easily found in biology.

### 13. LARGE SCALE SYSTEMS AND INSECT SOCIETIES

To study the complex behaviours that arise in systems composed of many interrelated components (large scale systems), like the IM, we could look for a generalized modelling framework. This
framework should also serve us by give some guidance of laying out the programming framework to be used to develop a simulation’s model. An early observation is that many a complex systems identifiable in the real world share a common architecture very often caught in the paradigms of object-oriented programming and cellular automata. This architecture we refer to as a "swarm", the notion coined by Chris Langton, and it denotes a large collection of simple actors (agents) interacting with each other. The classic example of a "swarm" is a swarm of bees, but the notion of a swarm can readily be extended to other systems like a colony of ants, a flock of birds, a collection of molecules, cells, cars, economic agents or any collection of actors showing a collective behaviour. This architecture or model is meant to elucidate the collective behaviour of the swarm and the essential feature that of a collection of relatively autonomous entities with no central organization. What makes swarms important is that, in spite of the seemingly simple behaviour of the individual their collective behaviour in many respects turn out to be highly complex and could under many circumstances appear to be intelligent. That is, in that respect swarms allows us to focus on the roots of complexity and intelligence and could likely illuminate the point at which simplicity becomes complexity, where emergent properties arise or where the individual’s irrationality becomes an seemingly intelligent behaviour of a collective. That is, we turning to such phenomena the state variables normally used in the physical sciences, such as temperature or pressure, are no longer the variables by which complex behaviour is manifested. Instead new elements and properties emerge and terms like interaction, strategy, anticipation, and co-operation, become the important characterizing mechanisms.

To unveil some of these features let us for the moment abandon the scene of IM and discuss some aspects of the behaviour of social insects. The usual view of an insect society holds that nest construction, food searching, and other collective activities are the prototypes of a deterministic world in which individual insects are small, reliable automatons obeying a strictly established behavioural program. Today, this picture is fading and a new paradigm is gradually emerging in which random elements from the environment and an adaptability of individual behaviour begin to play an important role.

What is most striking is the existence of two scales: one at the level of the individual, characterized by a pronounced probabilistic behaviour, and another at the level of the society as a whole (the swarm), where coherent patterns characteristic of the species develop at the scale of an entire colony. We choose an example from G. Nicholis [Nic89] discussing food searching by ants and compare the course of this activity in two different situations. In the first, a unique, predictable food source such as a colony of tinier insect species (say aphids) whose lifetime is of the order of several months exists in the vicinity of the nest. In the second situation, an unexpected source, such as a dead bird or a second colony of prey species, suddenly becomes available. In the first case we observe the formation of stable trails from the nest to the nearby colony, each trail having its own specialized users. Moreover, few ants are found outside these main axes. Clearly, under the existing circumstances it is beneficial for the society to develop permanent stable structures with a low noise level, such as these trails and their patterns of use. In contrast, a permanent structure in an unpredictable environment may well compromise the adaptability of the colony and bring it to a sub-optimal regime. A possible reaction toward such an environment is thus to maintain a high rate of exploration and the ability to rapidly develop temporary structures suitable for taking advantage of any favourable occasion that might arise. In other words, it would seem that randomness presents an adaptive value in the organization of the society. This statement appears to be supported by the experimental data, to which we now turn our attention. The discovery of a new food source requires the mobilization of ants to ensure its efficient exploration. The mechanisms by which ant societies manage to assemble great numbers of individuals around food sources constitute food recruitment.

The above described dynamic behaviour of an ant colony could obviously be used as an analogy of the activities of IM, may be a bit oversimplified, but nevertheless striking parallel. The point of this analogy is an effort to unveil the structure and the swarm-like complexity of IM and must not be interpreted as an utterance in condescending terms. What we are looking for are some sort of basic entities that could make up the core of a model of the IM and some mechanism allowing us to simulate the collective behaviour of the actors of IM, that is something that remotely reminds us of the IM market.
A dynamical model of IM (or any human society) begins with the realization that in addition to its internal structure, a network of individual actors, the system is firmly embedded in an environment with which it exchanges matter, energy, and information. Software modules, individually tuned, could easily model such a system. In a traditional business firm raw materials and products arrive continuously, finished goods are exported, while mass media and professional communication keep the various local groups aware of the present situation and of the immediate trends. This exchange process clearly goes on between the nodes of the network as well as between the network and its environment. The evolution of such a system is interplay between the programmed behaviour of its actors and impinging constraints from the environment. Contrary to the particles or molecules of physics, the actors in a physico-chemical system, or even the ants or the members of other animal societies, human beings develop individual projects and desires. Some of these stem from anticipation about how the future might reasonably look and from guesses concerning the desires of the other actors. The difference between desired and actual behaviour therefore acts as a constraint of a new type, which, together with the environment, shapes the dynamics. Such behaviour is quite difficult to capture by means of mathematical modelling. Conceptual modelling in form of software modules, on the other hand, offers us means to develop units to justify this intuitive feeling and, at the same time, to specify more sharply the nature of the unpredictability of the IM.

The model just defined views the evolution as an autonomous process whose course is determined at each moment by the mechanisms of interaction among different actors. The environmental constraints act through the parameters, and the initial condition can be adopted to express the effect of randomness or of a systematic external intervention or "planning." An alternative scenario, closer to what happens in reality, is to let the system evolve for a certain period of time, brutally modify its state by launching a new activity or an "innovation," again let the system follow its autonomous dynamics until a new innovation is launched, and so forth.

Modelling the actors as classes of software modules (in an appropriate programming language), dynamically generating swarms of individuals and allowed to interact and/or co-operate as individuals by means of message passing and collectively by means of emerging phenomena (evolving phenomena showing up during the simulation’s experiment) is to use simulation modelling at its best. Simulation of such a model could establish the existence of a large number of patterns and intricate dynamic phenomena. Starting from a space in which variables are initially distributed at random, we could observe the gradual emergence of an organized pattern with no organizational centre. In the absence of any massive disturbance the pattern remains stable for a period or disclose a slowly evolving behaviour.

If a new activity is launched at a certain time, it will grow and stabilize, if the place and time is well chosen. However, if the same activity is launched at a different time, it need not succeed; it may regress to zero and represent an evolutionary failure. This illustrates the dangers of short-term, narrow planning based on the direct extrapolation of past experience. Such static methods threaten society with fossilization or, in the long term, with collapse. The principal message of the dynamical modelling advocated in this section is that the adaptive possibility of societies is the main source allowing them to survive in the long term, to innovate of them, and to produce originality.

The general form of a swarm simulation system will be a distributed, concurrent, object-oriented language combined with a set of windows-based tools for the specification and management of the swarm simulation. Users will be able to specify the behaviours of the individual actor (bees, ants, stock-traders etc.) making up a swarm in a familiar programming language such as C++, Lisp or Pascal. They will be able to specify the properties and the behaviour of the environment in which the swarm is embedded and the initial state and distribution in that environment. They will be able to instrument the simulation with various predefined data-collection facilities and data-graphic worktools, or they may define their own. Finally users will be able to run simulation interactively, altering the states, arrangement or the rules of the individual actors or the environment as they wish during the simulation. The ideal implementation of a swarm system would be an object-oriented programming language running on a massively parallel computer system.
REFERENCES


PRIVERSE - THE ALL-EMBRACING PRIVATE CONSCIOUSNESS.

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Abstract:
The assumption that there is one and only one external world of things of common access to all humans and thereby postulating an “objective reality” could seriously lead science astray. Another approach is the subjectivist, starting off from the hypothesis that there might be some external common grounding merely unveiling its existence by the impact of sensations sensible to a cognitive system and thereby “paint a strictly private picture of the world”. It possible to show that different observers discover through communication can establish a correspondence between their subjective entities in spite of this perceptual privacy and reach a collective agreement on objective knowledge without the postulation of a common real world in its physical materialistic sense.

This approach also confirms the Kantian claims; (1) that “das Ding an sich” is forever hidden to observers, (2) the knowledge we possess about the real world is ineffaceably coloured by the observer’s perceptual mechanisms, knowledge and consciousness and (3) the “outer qualities” of objects may cause sensations, but space, time and causality are given form only within the a priori spatiotemporal structure supplied by our minds. Such an approach also shows that all there is to human consciousness is a private comprehension about a “universe” - called the priverse. Abandoning the idea of an external material reality of common access to all observers also opens up a neat comprehension of human consciousness, as being our own very private consciousness, projected outwards from the constructive perceptual imprints of our minds to paint what was believed to be the common “classical reality”. Priverse is all there is to a living being - the meeting point of projected mind-frames and human knowledge. There is no outside or inside - no matter or mind - as far as consciousness is concerned - my consciousness penetrates everything.

In this setting science’s most sacred landmarks; objectivity, truth, and universe lose their taste of absoluteness; they all reduce into collective common agreements - bare paradigms in a true Kuhn-ian sense. Sort of a “moving average” - an ever evolving (?) collective agreement being in force within each specific scientific community.

1. Introduction.

Since classical antiquity there is an intimate interplay between physics and philosophy. They both lay claim to the description of reality, physics in particular the "worldly components" - the things of the world. Among others B. Russel (1961) has shown that prominent philosophers for a great length of time has delivered opinions on what “really” exists "out there". During the 20th century we have come to embrace the idea, that such "worldly existence" could be a delusion, something that is beyond the grasp of science and a thinking being. In physics this idea is most clearly pronounced by the so-called "Copenhagen interpretation" (Bohr,1968) and post-Wittgenstein philosophers like R. Rorty (1980).

Taking that stance the discussion of "worldly things" must be reduced to a discussion about the phenomena or "the mind’s imprints of worldly things" occurring to a cognising subject. For instance Husserl claims (1960) “Experiencing is consciousness that intuits something ... The first and most primitive concept of the phenomenon refer to those which Nature is evidenced in perceiving”. Here such phenomena per definition are called perceptual imprints – i.e., the cognitive nervous system’s reaction to the impact of a bundle of stimuli coming from “outside”. These perceptual imprints emerge in the mind of a human being – more precisely in its mind-frame (its consciousness) - that is the "visible" result of some the brain-internal processes. That is to say, the neural perceptual imprint occurring in the mind-frame is juxtaposed to the content of human consciousness.
So defined, a human mind-frame could not possibly be the target of traditional scientific observations. This in contrast to the neural patterns rising inside a nervous system or brain, which are the subject of tenacious study in psychobiology and neuroscience. The mind-frame of consciousness is inaccessible to any other human but the subject itself and thus to objective observation. This is so unless we are willing to recognize the possibility of telepathic communication. What are left for an objective science to study are the concrete neural processes appearing in the brain and the descriptions of mind-frames, i.e., descriptions of the content of private consciousness.

Such descriptions take on many forms that all can be regarded models expressed in a specific modelling framework (a language). One such framework is the spoken human natural language, which is often seen as the primary cultural device used for inter-subjective communication, Lotman(1967), and other frameworks are very often regarded "secondary" (or derivative) translations of some natural language.

Thus we specify the worldly things by modelling, and this idea can be further generalized to include descriptions of any phenomenon whatsoever – may it be concrete or abstract. However in such a setting we must consider the description presented to model (or re-present) a phenomenon in the mind-frame of the observer/thinker and certainly not the worldly thing itself – the presumed original. In this situation the reason of the emergence of the mind-frame is of no great concern at this stage. To sum up; we consider every model to be an observable token of knowledge and what is more important; this is the only token of this knowledge that resides “outside” the knowing subject, for the reason the mind-frame is directly accessible only to the knowing subject itself. This principle we call the primacy of subjectivity.

2. The framework of scientific modelling.

In science models are used for description, explanation, prediction and control. As already explained the observer’s role is important in all scientific inquiry, but when discussing modelling efforts this role of his is unfortunately often kept out of the way however. As a counterbalance this paper concentrates on a subject-oriented constructivist view of the modelling process that elevate the role of the scientific observer and his desire of inter-subjective communication.

In doing so it seems natural to turn to an ontological view when seeking a formal base of modelling. The branch of philosophy that deals with the modelling of things in the world is called ontology (or metaphysics) and Bunge (1977) here provide a good example. Scientific ontology is a collection of intermingled interdisciplinary frameworks and theories often very mathematical in form and so are the conceptual frameworks of physics and general systems theory (GST) that are most often used to lie out the principles of modelling. For use in systems modelling there are many proposals to formal frameworks, see for instance Klir(1969), Mesarovic(1975), Padulo(1974), Wymore(1977), Zeigler (1984). However their mathematical quality often makes them too abstract to serve as useful tools when it comes to interdisciplinary communications. This is very often the case when the community of the natural sciences encounters the community of the social sciences. There is a lack of understanding due to fundamentally different worldviews and the absence of a common conceptual framework to discuss modelling efforts can be very frustrating. This paper instead makes use of an intuitive approach that supports a neat visual modelling analogy in an effort to increase the understanding of the modelling process as such and the frameworks of modelling available.

3. The knowing subject and its importance.

Classically the modelling relation is very often depicted as in figure 1 - Rosen(1991), Casti(1988): The "reality" is seen as mapped into a model, very often taking the "reality" phenomenon for granted, and the rules of modelling for self-evident. The inverse mapping that is when we interpret the “model behaviour” in terms of the corresponding "real world behaviour" is called the interpretation of the model. However this classical illustration of the relation
between the “reality” or some thing or system belonging to “reality” and its representative model can indeed be very misleading.

A more workable definition is proposed by Minsky (1965):

To an observer B, an object A* is a model of an object A to the extent B can use A* to answer questions that interest him about A.

This definition takes the observer of the system in consideration and furthermore underlines that the purpose of the observer and his goal has a decisive influence on the formulation of the model. I will suggest a similar definition:

A model is the sign of the content in observer’s mind-frame cast into a specific conceptual form.

We thus bring out the content of the observer’s consciousness and its external signification - the model. Another advantage of both these definitions are that they lend themselves to a neat visual interpretation.

The presence of the observer is essential, since there is no knowledge without both an object of knowledge and a knowing subject. It is also very obvious that every statement, present in any verbal model or language, tacitly understands an observer C. Every statement is in that sense a description about something that C - the observer - has "observed in the world”, i.e., sensations that C has felt coming from outside itself, or some "thoughts or feelings generating sensations coming from inside. This manner of speaking immediately suggests the dichotomy internal/external for classifying phenomena relative to the observer C. In order to formulate his philosophical ideas more concisely Descartes (1641) took another route, he made a principal distinction between two separate domains - res cogitans (mind) and res extensa (matter), since he recognized that cognitive processes are possible without any appeal to the concept of extension in space. This step was the confirmation of a fundament of Western science - the dichotomy of matter and mind. The impact of his ideas was monumental and as P. Johnson Laird (1988) put it "dualism, as Descartes’ philosophy is called, is so potent that the history of psychology is, broadly speaking, little more than a series of reactions to it.” Science has have never agreed about the best way in which to study the mind, or even whether there is a proper object of such a study. R.Rorty (1980) among others claims that the ”invention” of mind is unnecessary and ..... The deep-rooted matter/mind dichotomy is also mirrored in a long line of contrasting relationships - real/unreal, concrete/abstract, material/immaterial, factual/conceptual etc. - and it is obvious that all these dichotomies more or less rest against and elevate the human sense of touch to provide the ultimate decision procedure on what is "real" contrary to "unreal”. This suggests, for instance, why the everyday man meet with such a feeling of inconvenience when discussing non-touchable phenomena like electromagnetic fields and the like.

4. The human mind, consciousness and priverse.

Sticking to any of the above mentioned dichotomies inevitably leads to place ”reality” on an equal footing with what can be discovered by ”touch physics”. Inasmuch good, since what is touchable is believed to be collectively accessible and could therefore be the sound base for collective knowledge. But science strives further, beyond what is touchable, and in that respect it will turn out that the establishment of an observer-relative dichotomy is rewarding. By the use of the dichotomy
The importance of the content of C’s consciousness is very much brought to fore. Naive realism takes for granted that there is one and only one world "out there" which consists of "real objects" or things, making up an objective reality. Accordingly the task for science has partly been to unveil the hidden secrets - the furniture of the world - existing in this so-called "true objective universe". This view is tacitly underpinned by the profound idea of permanence, which in turn has paved the way for the overwhelming interest that science has shown to these material entities - the furniture of the world. The scientific research proceeds on a number of metaphysical hypothesis, which has been pointed out from time to time. Two points of a list of ontological principles – Bunge (1974) - occurring in scientific research must suffice here:

There is a world external to the cognitive subject.
This world is composed of things.

That is to say classical physics has to great extent seen knowledge as a passive reflection of the external objective reality. The view of naive realism is that the observers senses work like a camera lens that just projects an image of what the world “really is” onto his mind, and use that image as a kind of map, as a description of the objective structure "out there", disregarding the possibility that the content of his mind-frame could be a private construct, not to be confused by anything deserving the attribution something "objective". In this case the utterances made by him regarding the "appearance of the world" have reference to his own priverse (private universe) and the statements expressed are in that sense a model of priverse and nothing else. For sure a very faint model (or representation) of this very private mind-frame - but nevertheless a model.

There is also another objection to be raised to the postulation of an "objective reality"; since we could not ever be sure there are anything at all "out there". The most radical standpoint of scepticism is solipsism - according to which all there is, is my consciousness and its content, i.e., the "world" is only in my imagination and the only reality is "I" - the "imagining observer". Such a stance is perfectly defensible provided that I am the only living being in the world. When introducing other living beings and adopting the principle of relativity, which states that we have to reject a hypothesis when it does not hold for two instances together, things stand out in another light - von Foerster(1974).

On these grounds we reject solipsism and in doing so we propose there is something "out there" - the reality grounding - and consequently we firmly establish the external/internal dichotomy. When doing so we are in need of a term to denote "phenomena out there", or phenomena hitting the receptors of the cognitive system. Unfortunately, the concept of "thing" turns out to be very complex, and it is therefore advisable to start off with simpler concepts when discussing external worldly phenomena.

5. Subject-oriented constructivism.

The subjectivist’s approach is not new, in physics it has been tried by Whitehead (1919), Nicod (1923) following leads given by Mach and Russell, and independently of Carnap’s (1967) similar attempt – that tried to build physical geometry out of (common sense) psychology and later Basri (1968) and more recently Lucas (1973). The subject-oriented approach uses a different and observer-cantered model of perception (figure 2). The underlying model of perception, here reminds us that the individual’s phenomenal world is private and disparate to each of us. In this model each observation results from the interaction of the observer with the observed and each observation is observer-dependent and therefore in a sense unique of this observer. Here it is very important to note that we stay free from the realist’s tacit assumption that the process of scientific observation is observer-independent. The acceptance of this model most of all need an explanation how it is possible to attain consensual understanding under such circumstances.

Constructivism – as advocated by von Glasersfeld (1984) for instance – in contrast to realism does not to postulate the existence of a thingy reality or an "observer-independent" process of perception. Taking that stance, we must ask what there are then to be sensed "out there" that could deserve the notion "some thing"? These “things” are gathered under the notion of the "clues from outside" – that is unknowable in principle we will find out in the end. To the cognitive system, on the other hand there are the feelings of the stimuli making up the mind-frames of consciousness, which provide the prime stuff for the build-up of private knowledge. We note that some of phenomena of the mind-
frames are knowable and others are not. We define a knowable sensation/phenomenon as a re-
cognisable one, i.e., a sensation that has been felt before and therefore fits into an internal schema of
organization – a conceptual schema. Such a sensation/phenomenon is caused by stimuli coming from
“outside”. The impact of stimuli that give rise to a sensation is defined as an external event, and is at
the first stage considered very private. That is, we admit that “the external events of universe” are the
casual precursors of our private sensations - which make up our priverse.
We also specify that a group of events is another event – and alas that a given event can at will be
decomposed into sub-events. This is the principle of relativity applied to the event conception – in the
same manner it can be applied to the system conception. The choice of resolution level is private
and chosen according to the observer’s goal, but we must realize - as argued by Fields(1989) - that there is
a principal level of the power of resolution and therefore also the quantification value (“stimuli
intensity value”) to be attributed to it. Thus any observable stimulus is in principle discrete.
Here is not the place to enter deeply into this subject matter, we just note that an observable state
space is in principle discrete and for that reason one necessary condition for system-internal Turing
computability is at hand. Mathematical continuity is a fiction only utilized to produce a smooth theory
only. We also appreciate - as indicated below - that the space-time frame of observation is created on a
private basis at the very time of observation and that this frame of observation is a local construct
serving the sole purpose of system-internal organization. We here urge the reader to consider this new
subject-oriented situation that totally reverses the picture of scientific organization – science anchors
in human observation – not in some principles of mathematical idealization that is thought common to
whole mankind.

6. Events and the time orders called a process.

In consequence we are just interested in knowable sensations and in doing so we at the same time
there are more but one single sensation. This follows from that a knowable sensation must thus occur
"after" its "prototype" sensation, which means that a knowable priverse could only be established by
the means of an order relation $T$. Let $x T y$ mean that sensation y "is after" x or equivalently that "x is
before y". This order relation $T$ is called a local time order. We use natural numbers N to establish a
local time order among sensations. This is most easily brought about by mapping a succession of
sensations say; \{ a $\rightarrow$ b $\rightarrow$ c $\rightarrow$ d $\rightarrow$ e \} upon the natural numbers $N = 1, 2, 3, 4, 5.....$


We do not know how a living brain store and keep track of memories but at this point is the question how the physical storage inside a cognitive system is accomplished is unimportant. All that matters is that computationally there is a need of "new" attribute (time order) to maintain the ordered sequence of sensations. We could as well simulate the order-preserving ability of the human brain by a chaining-procedure or a linked list as well. When storing this linked event chain or list, the cognitive system just need the start address of the chain in order to access the whole list for further use. Such an ordered sequence of sensations defines a trajectory or line of behaviour. We must emphasize that any event chain is a private cognitive system-internal construct and the time order signification is accomplished merely to keep up the order of the observations.

7. The emergence of local time.

To keep up the order among consecutive mind-frames in an event chain is thus the responsibility of the cognitive system – or rather its brain. Such a skill has a great survival value and is clearly of crucial importance in processes of inference. Still greater an advantage is gained, when the cognitive system add to it also the ability to estimate the duration between to related events. The clue to such a skill lies in the cognitive system’s ability to "sense a temporal distance" or "measure the duration" between two successive events. An internal biological process - called the biological clock, underpins this intuitive feeling that we call the "pace of time". The “pace of time” is a thus a feeling generated at a very private level. To be able to re-construct the temporal features of an occurred event trace - when thinking, imagining or simulating for instance - a cognitive system make use of the "number of time ticks" - the time interval - between two successive events. This is called a process of synchronization – the events of the chain are sort of spread out on the domain spanned by the ticks of the biological clock. And this is the end of the road – the question about the regularity of the time ticks is undecidable.

Thus time could be considered a biological “sensation” if it where not for the fact we cannot “feel time by the senses” – which is the definition of a perceptual sensation. For the time being we must resort to the idea that “time” is a feeling – an “inner” counterpart to sensation. In this situation, however, it is very evident the concept of "objective time" must be constructed (specified) outgoing from the concept of local time and this shows the protected debate whether there is "time in reality" – i.e., apart from any living being. The answer is no – time emerges in a living being only and is used as a mean of organization of experience. In consequence there is neither a specific category of "mathematical time" - just the mathematical representation of (biological) time. “Time reversal” is then a pure abstract mathematical construct and has no counterpart in some living experience whatsoever. A series of mental events taken in the reverse order - or otherwise - generally represents nothing but a pure fiction.

A time succession is a historical record and any observation in consequence a piece of history. The reversed series could be of interest only if such a reversed record is also historical – i.e., has occurred before. In such a case the sequence (or process) is called reversible, i.e., if played backwards the happenings make sense (the time order has been perceived before) to use a movie analogy. Very few processes fit into such a characterizations. So the “arrow of time” is the arrow of experience” and its reversal a pure fiction only.

We have dwelled on the time concept to underline the differences attained by the subject-oriented approach as compared to the traditional object-oriented one. The concept of spatial distance - i.e., the human space conception – can be handled exactly in the same manner. In a constructive framework we do not attribute properties to space and time at all - we just consider them an internal frame of
organization of the cognitive system. This idea is not new since already Kant (1781) proposed it, but its re-emergence is astounding and we understand the prescribed “objectivity” of science for a long time has stood in the way of such recognition.

8. A living mind creates its own personal priverse by outward projection.

We take another step on the way of subject-orientation when we understand that the "input stimuli” that are unable to excite the input receptors of a cognitive system goes "unseen” by the cognitive system. What is “unseen” could not participate in the build-up of a mind-frame and is for that reason privately non-existent. We understand that the content of a mind-frame (what is perceived) is to a great extent dependent on the receptor outfit of the cognitive system in question. We conclude that every event - external or internal - is defined by the perceiving cognitive system in question – and no one else. This is a very important assertion that inseparably ties together the object of observation and subject doing the observation. What is unperceived – by accident or deliberately – does not show up in the model either, which also ties together the subject doing the observation with the features of the model.

Furthermore we understand that the presumed stimuli impacts occurred to a cognitive system – no matter if they are considered a single event of a set of events - are the primary "object of observation", thus replacing the traditional "things of reality" as the primary objects of observation. This totally reverses the picture of cognition – the world of experience is constructed from inside-out. Of course the ability of the senses of a cognitive system can be reinforced or extended by the use of a measuring device or instruments or the like, but this fact does not make any principal difference whatsoever. At the observing end – in human consciousness - there is still a system ready to define what he or she thinks is a "worldly event" - and what is not.

We understand the events “as-seen-out there” is caused by the occurrence of the internal mind-frame and the "appearance" of the phenomenon “out there” is the “content” of the internal mind-frame emerging to the cognitive system. These highly private internal phenomena - the mind-frames are for sure the only signs of the “outside happenings” – the occurred events – we have, and in other words also a primary presentation of the in this way externalised event. This primary presentation is "calculated" from the output of the cognitive system’s interface receptors. (Figure 5a)

From an infological point of view, the relation x \(\rightarrow\) y can be regarded as a pure coding relation. The "appearance of y” or any of its successors (the perceptual imprint), actually does not emerge until the resultant complex sensation has been compiled in the observer’s mind. The resultant sensation has also very little in common with the envisioned original "stimuli train" to do, apart from the "triggering action” accomplished by it. Nevertheless this occurred mind-frame transition is in fact the only way to define an external event. When such a mind-frame transition occurs its cause is, by the observer, located to the estimated source of the message. When the source is considered external to the cognitive system, the “appearance of the event ” is projected outwards onto the “external reality”, since this is the only way we appreciate the existence of any rising mind-frame which is externally triggered. (Figure 5b) - a similar proposal is also brought fore by Velmans (1990). This situation creates another problem since this seems to be a very loose basis to build the idea of an "objective universe” upon - for not to say impossible. There is no way back however, this is all there is to human cognition! The crucial question is rather, whether we can come on speaking terms with our fellow living beings regarding the generality of these phenomena of cognition or not. This is the new challenge – is this possible then there is the possibility to define what we really mean by an "objective universe” – or then rather a consensual universe.
For a physicist it is really a bit astounding to in this context find a “projection mechanism” in work that has been well-known and established since the days of Sigmund Freud’s. This classical projection mechanism of psychoanalysis suggests that one’s own feelings, attitudes, or desires are unavoidably and unconsciously attributed onto other beings. Psychologist and analysts have been especially interested in projections used during pathological mental conditions, and now we here see the same mechanism in work hale and hearty; “one’s internal sensations are attributed (or projected onto) an /unknown/ reality - thereby making this reality seen – i.e., creating as priverse”. These considerations also unveil the very essence of statements like: "What is out there, is hidden to any observer” or ”/das Ding an sich/ is not knowable”. We will in that vein discover that also truth loses its absolute flavour – we will to our surprise find that truth is hidden to all observers. We will meet with the embarrassing situation that unless we appreciate the existence of a God or some other divine "super-observer", also admitting the possibility of communicating to them, there is certainly no way to establish such an absolute truth.

9. To clear the discussion of divine metaobservers.

Such an insight is very close at hand now. All we must do is to remove references to divine metaobservers - explicit or tacitly. We refer to figure X: C is a woman watching a coloured patch. The outsing 1 stands for which to C means that her experienced “mind-frame” is a light one. C’s sense of is outward projected onto reality, which constitute C’s experience of a "light patch”. This will make sense, we think, provided that reflects the "real state of the patch”, and in that case called a “true model of the patch”. Since nobody ever knows the "real state of reality", however, we must conclude the truth of such an observation always must be relative to somebody else’s observation. Since I am the observer, I make a reference to myself and in this case my observation and now taking the stance of a metaobserver1. Suppose now the C’s mind-frame changes to of some “internal” reason, then C signifies 0 and I as a metaobserver conclude this to be a false model, i.e., a mistake. This is a conclusion I very easily take on as meta-observer, when observing a "light mind-frame” and simultaneously C’s outsing 0 – I hastily conclude that S is mistaken. In doing so I unfoundedly claim and that my own perception is true - the correct one. However this is not so2, on the contrary, my perception could not without any ado possibly classify more "correct” than C’s. How do I know I am not mistaken? Of course, I could never be sure, all I can do is to make certain arrangements to assure that my judgment is highly probable - more probable but S’s anyhow. My mistake was to appoint myself a metaobserver in secrecy and disgraceful confusion This give rise to another problem - how to arrange a base of such a probability measure - that we will tackle in the next section.

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1 A metaobserver is an observer watching another observer.
2 this sentence is better rephrased into “this opinion cannot be useful"
10. Lies and mistakes.

Now suppose it is possible to establish such a probability measure and suppose there "objectively" is a high probability that S is mistaken, that is to say that S’s percept-to-world projection is "classified defective". However the talk about S’s “mistakes” and "defects” reveals another possible flaw. How could we be assure us that S is “mistaken”, it might be that he deliberately tells us a lie. That is to say, that he on purpose does not apply the agreed-upon presentation rules (the agreed-upon rules of percept-to-sign transformation), i.e., the presented outsign is a deliberate fake. We hastily conclude, that unless we are able to observe C’s mind-frame there is no way to decide whether S tells us a lie or simply make a mistake. Such observations are simply impossible. In our self-assumed role of metaobservers we have made ourselves also divine and making myself a divine metaobserver is the apparent mistake – and this mistake is made over and over again in our daily scientific practice – and not only there. The internal processes of a self-alien consciousness (active or passive) are unreachable to other observers – the primacy of subjectivity – in particular to scientific observers since we do not follow the prescribed Newtonian paradigm when doing so. Consequently the only allowable observation of such internal processes is the sign or message made visible (perceivable) by a model statement. In order to reconstruct an experimental situation (i.e., pure cognition) we must refrain from some self-assumed state of divinity, allowing ourselves to just observe the model statement presented by the other system.

11. Are mind-frames comparable?

Assume that we can arrange such that two cognitive systems watch the "same" external event\(^3\) X and then ask whether they have both the "a similar mind appearance of the event X". There is no answer to such a question, as pointed out, since no one besides the cognitive system itself - not even a metaobserver - can observe the internal mind-frame. Let us instead ask if the precursor to the mind-frame - the brain’s neural pattern - could be similar. The cognitive sciences of today agree on that the "same agreed upon external event" can give rise to different mind-frames by virtue of the knowledge feedback occurring in the living brain. Accordingly the mind-frames (appearances) are also different in different cognitive systems. Can this situation can also be valid in the case the neural imprints of different brains are similar? This question rebounds classical dualism – is an eventual neural brain pattern separated from a mind-frame? In the subject-oriented approach a brain pattern is nothing but a data record – and so is a mind-frame – probably they can be made similar by the choice of model – what else there is undecidable. Such a remark is necessary and very important, since my assertion is that the immediate sources of our models are exactly the mind-frames arisen in our minds and certainly nothing "out there". What a scientific community can compare are models – and the structural content of models are dependent on the framework (language) used for their explication. We must conclude even similarity is relative.

But how come most English-speaking human beings agree on what is "red" for instance\(^4\)? The reason seems obvious, a mother presumably being the first one to teach a child how to denote the mind-frame raising its mind, when watching "red" things together. By repeating this procedure a large number of times with different "red objects" on different occasions, the mother’s knowledge soon becomes part of the child’s knowledge. Assuming the mother’s knowledge to be close to the common collective opinion on what is "red", the child’s knowledge also becomes so, independent of the "actual\(^5\) appearance" of the mind-frame. What is “really out there” is hidden to all living beings, as is the features of the mind-frame rising in the child’s and mother’s mind, and we conclude that such speculations are futile – because such questions are undecidable. This must not necessarily been seen as imperfection – it is plainly a consequence of ill-considered questions. Nevertheless, by acting

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3 To come on terms regarding what is the "same phenomenon " is far from easy, but we cannot enter upon that path here and postulate that such an agreement is possible

4 This task is more but a knowledge of language, since "red" in the setting sun is a very different sensation from "red" in bright daylight

5 which is unknowable
together cognitive systems share and build common knowledge and by acting together in a scientific community we will see its possible to build scientific "objective knowledge", without any postulation of any "real world" composed of "things" of general access to all of us. We call such knowledge consensual – since the term “objective” is worn out.

12. The objective reality.

As mentioned before a similar path has been entered upon before and Basri (1968) has pointed out the concept of the objective macroscopic universe can be established in two steps:

1. An observer discovers there are similarities between many of his sensations, and attributes each subclass of similar sensations to a subjective entity. There is no justification at this point of assuming these entities to be outside the observer; they could well be the result of a mental process such as a dream. (that is a discussion whether this objective universe is real or not is pointless)
2. Different observers discover through communication that they can establish a correspondence between their subjective entities, and then attribute the corresponding subjective entities to an objective entity (macroscopic object). The class of objective entities is called the objective universe”.

The first step of ”objectivisation” is consider how two observers C and D can to get together on the validity of their sense impressions coming from the "same” source A. We assume C and D by a set of activities can come to an agreement as to that they are watching the “same” source A. This is the first agreement to make – to agree on the address of the clues from outside phenomenon.

I assume myself to be D observing the doings of C and the source A (fig 6) – the “actual state” of A is unknown of course. We also notice that D is need of at least two receptors to observe the “state” of A i.e., to create my phenomenon of A and C’s outsign i.e., to create my phenomenon of C’s sign simultaneously – that is in the same mind-frame. Sticking to a two-stated external phenomenon A, C’s outsign could be 0 or 1. Assuming that C is not mistaken or a liar and assuming that my mind-frame is "light” = we face the situation in following table:

<table>
<thead>
<tr>
<th>D</th>
<th>C</th>
<th>A</th>
<th>C and D</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐</td>
<td>1</td>
<td>?</td>
<td>both agree</td>
</tr>
<tr>
<td>☐</td>
<td>0</td>
<td>?</td>
<td>they disagree</td>
</tr>
</tbody>
</table>

By observing C’s outsign =1 (which according to the convention stands for our light mind-frame ☐) we are settled and we conclude that A signals "lightness" ☐ also to C and that the "objective” value of A is =1. However is not there still a probability that both C and D are hallucinating? Yes and no! For C and D to be mistaken at the same time we have to introduce a God – without a God or some other reference they cannot both be mistaken – since there is no certified truth. Since we are agreed we have a “useful” decision – call it a hallucination or whatever.

When I, on the other hand observe the outsign = 0, we could not come to any consensual agreement without any more ado, since both C and D must be considered having the same trustworthiness. To avoid this situation depicted above, I - as D – or C can increase the trustworthiness (strengthen the self-confidence). There are several different ways to arrange for that - similar in principle. Let us assume for instance:

1. D is a "certified observer”, i.e., a certified measuring equipment
2. D is considered a "skilled observer”, a certified expert observer
3. D invokes further observers - which agree with him

Then we have situation at hand that will make my judgment more probable. The more unanimous observers, the more probable that the ”agreed upon value” reflects a wide collective opinion. The number of unanimous observers could certainly be the base for such a "truth probability measure”. Theoretically we should maybe also weight in the "skills of the individual observer” when calculating such a measure. But then, who is the one to judge the skills? We argue this is the only meaning we can assign the concept an "objective” value, i.e., a value agreed upon reflecting a wide collective opinion –
consensus or a general _collective scientific agreement_. Since a mind-frame - a private construct - is build from a multitude of private sensations (values) unveiling our _personal priverse_, in analogy the universe or the “objective” reality is a _bare construct_ build from a multitude of priverses - a general consensual agreement on the properties of universe. We see that when an observation is sufficiently repeatable, a _collective science can be established by agreement_ and further discussions show that a collective agreement requires merely that the _individual experience are sufficiently similar to be taken for ‘signs’ of the ‘same’ phenomenon._

Research on spatial localization in various sense modalities, perceptual illusion, and “virtual reality” has clearly demonstrated that a mind-frame is a creation based on clues from outside. (Re)presentations of “external” events are actually formed within the subject’s brain as neural imprints, but the “appearance” of the imprint, is by the mind, outward projected to the judged location of the events they represent. With this model of perception, the emerging mind-frame is part of human consciousness; it cannot be thought of as separate from consciousness. We thus see that the priverse arise as a collection of _mind-frames_ in any living being - which thus is to be interpreted as the _private individual universe_. But universe - the scientific phenomenon - cannot be derived from any phenomenon at all, neither any mind-frame – _the universe is merely a scientific agreement_.

A _expert observer_ is one, whose observations is in accordance with the accepted scientific collective agreement, a certification which is only achieved by means of experience, experiments and communication. The skills of a certified observer is also often by ingenious engineering materialized as a _certified measuring equipment_ consequently serving as _an authority of observation_, merely assuring “objectivity” in the above mentioned sense. The way to become an expert observer is obviously to build knowledge together with another expert observer. A mother - being the first expert observer - teaches a child how to handle the mind-frame rising its the mind, when watching external events together.

### 13. Human consciousness.

We have seen there are as many priverses as there are living beings, but hopefully all human priverses are sort of ”similar”, in virtue of the human inheritance and common upbringing. Other living beings have for sure very different priverses, since their receptor outfit is very different from the human. The ”observer-relative” truth we call _an opinion_ being part of a body of private knowledge and the ”science-relative” truth or ”objective truth” we call _a fact_, being part of a body of scientific knowledge.

Priverse is my own private reality - the emerging mind-frame occurring to our mind - rising as a consequence of the neural patterns built up inside our brains from the sensations occurring to our nervous system. Physiologically these neural patterns reside inside our brains - i.e. the source of our mind-frames is probably located in our brains. However this does not by necessity imply that our consciousness is ”located” to our brains only. Here is the point where Western thinking falls short. Consciousness is nothing physical - consciousness is rather intangible. The ”shining sun” is ”out there” - not in my brain - as is private ”the appearance” of the ”shining sun”. I make reference to the ”shining sun” by pointing ”outwards” i.e., the ”shining sun” - which is my privately experienced ”shining sun” is _outward projected_ by the me onto its ”external location”. But my consciousness being both in my brain and ”out there” - two images - one in “full-scale out there” and a ”miniature inside my brain”? Strange - this does not make sense? But yes - it does! When I consider my consciousness to be all-embracing - my consciousness is neither “here” nor “there” - my consciousness is all-embracing. To me all there is - is my priverse - and my priverse is boundless. My priverse and consciousness admits no physical boundaries - consciousness is non-physical and all-embracing - and my priverse is a non-physical all-embracing and emergent phenomenon. My priverse emerges provoked by the clues from outside – constructed by my perceptual apparatus. This is my belief, which has proven very useful, and I stick to it as long as it works well. This is also your belief – since we have erected a common body of knowledge called science on this belief. Taking those stance centuries of scientific antagonism can be settled. In next section we shall see that Kant and Berkeley can come on speaking terms.

A description (a model), by definition, describes something, i.e., there can be no description in and by itself, or a "Vorstellung an sich". We have seen such descriptions has little holding-ground in "reality", this is a description of the contents of the mind-frames arisen inside an observer - a private (or subjective) reality. Kant (1781) developed a very influential philosophy of his time. The ideas of Kant has come into a renewed actuality by the progress of quantum mechanics and the problem brought to fore by its interest in the observer’s role in physics. Kant argued that what is "out there" in reality is beyond human reach, that "das Ding an sich" is forever hidden to any observer - which also is interpreted in the paper. Space and time, on the other hand he argued, form an essential part of our intuition or mode of perceiving reality. Although other qualities of objects may cause sensations, these sensations are given form only within the a priori spatio-temporal structure supplied by our minds - they are contrary to "das Ding an sich" which exists outside space and time bare creations of the human mind. We also agree on that.

Taking Kant’s stance, I claim another conclusion is obvious, there must be as many "realities" as there are living beings - since "das Realität an sich" is beyond the grasp of any human. All there is in living consciousness, which for sure is a private model of "the reality" and a private comprehension about "universe" - is the priverse.

A similar idea was expressed by Berkeley (1713), when coining the well known "esse est percipi", to exist is to be perceived. He claimed that consciousness about the world is all there is - consequently the world does not exist outside consciousness. Berkeley’s predicament was, that it is very difficult to take the stance that worldly thing does not exist outside consciousness – and he therefore made reference to God. On one side, we speak about the "reality" and the "things out there" as something separate from consciousness and on the other side maintain that consciousness is all there is - evidently impossible. But not so - this stance is perfectly defensible providing one talks about the private consciousness of a world "out there" - the priverse. To any living being the priverse is all there is and the factual source of any private description (model), since "das Realität an sich" is non-observable. We come to Berkeley’s help by claiming that consciousness is boundless. Our private consciousness is "out there" and in our minds - priverse is all there is to any living being. What is "out there" is not beyond human reach, "out there" is in our consciousness - priverse is all there is. There is no outside or inside, as far as consciousness is concerned - consciousness penetrates all, and consciousness is strictly private - and consequently subjective. All there is to a living being - is the priverse - the subjectively experienced universe.

This is disgraceful - we have seen what happened to science’s most sacred landmarks; objectivity, truth, and the sacred common universe, when we pursuing this line of investigation. They lose their taste of absoluteness - perhaps not surprising in this century of relativity - they reduce into collective agreements - or bare paradigms in the true Kuhn-ian sense, Kuhn (1962) - sort of a "moving average", an ever-evolving collective agreement being in force within a specific scientific community. Consequently "objective" perception is impossible and "absolute truth" is a misconception - science and world-views are reduced into a disciplinary collective agreement the content of which we are educated and trained to comprehend. Every "real" thing, including the universe is "unseen" by any human being - but certainly not incomprehensible. All there is to be seen is - the private unique universe arisen by messages from "out there" which are richly coloured by our own imagination and knowledge - our own priverses.

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FROM DESCRIPTIVISM TO CONSTRUCTIVISM - A CHALLENGE TO SYMBOLIC MODELLING.

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Abstract:
Classical modelling is not isomorphic, on the contrary, the “objects of reality” or the like are the source of a homomorphic mapping performed to produce the model – just as a piece of landscape is portrayed by its map with some bewildering details left out. Our education has taught us that this process of modelling (or abstraction) is a plain mapping procedure - we call it descriptivism or representationalism. The prevailing object-oriented (or realist’s) modelling approach has some serious shortcomings due to the negligence of some aspects of the observer function, which for instance has resulted in a “world definition” made from “outside” the human mind. By reversing this picture and instead of using the impressions which have arisen within the subject’s (the observer/knower’s) conscious experience - the phenomena - ask how a living consciousness organizes itself to handle the task of living, we can then gain new insights into the process of conceptualisation and learning.

In the subject-oriented approach, which is its name, we learn that the dualistic worldview (dualism) is superfluous and is replaced by a neutral monistic approach. There the existence of an independent outside reality (realism) can be substituted by the idea of a “reality” constructed from the “inside” of a living mind - that is nothing other than a set of models whose main purpose is to guide human anticipation and facilitate communication. Taking this stance the main tasks of the human mind become just modelling – the creation of an “outside” model-reality and the “inside” domain of human feelings.

In such a framework, the classical truth - in the sense of a God-given modelling truth loses its classical meaning - and must rather be substituted by a Pierce-ain pragmatical or consensual truth. The subject-oriented approach claims that states, properties etc. cannot be not given any observer independent (absolute) existence. On the contrary they emerge at the very time of their measurement - a situation advocated by the Copenhagen interpretation. Bell's theorem also states that given quantum mechanics, either the idea of Einstein locality or the idea of an observer-independent reality must be abandoned. The subject-oriented approach clearly abandons the idea of a pre-given observer independent reality - in favour of a cognitive agent’s created private reality (priverse), which then becomes the base for defining an “objective” reality in the form of a consensual scientific agreement.

1. Introduction.
The aim of this paper is to introduce the reader to the ideas of the subject-oriented approach of modelling1,2. The prevailing object-oriented approach – or realistic approach - has some serious shortcomings due to the negligence of some aspects of the observer function, which for instance has resulted in a “world definition” made from “outside” the living mind.

By reversing this picture and instead of using the impressions (phenomena), which have arisen within the subject’s (the observer/knower’s) conscious experienceA, ask how a living mind organizes

A To avoid the inarticulate concept of consciousness I also lump together all human observation occurring at the level of awareness – whether external-internal - to one central concept; conscious experience
itself to handle the task of living, we can gain new insights into the process of conceptualisation and learning. We learn that the dualistic worldview (dualism) is superfluous and would be better replaced by a neutral monistic approach. Many phenomena which seem very puzzling using the classical object-oriented (realist's) approach turn out to be very natural and obvious in the subject-oriented approach – but unfortunately one has to re-orient one’s way of thinking considerably to appreciate this new point of view.

We regard this reorientation, as a possible shift of paradigm in Kuhn’s sense – to advance science must abandon descriptivism in favour of constructivism.

We want the ideas and principles presented in this paper to be accessible to a wide interdisciplinary audience, and this dictates the rather informal style – and some necessary short cuts are taken in order to carry the discussion further on the intuitive level. This must not be mistaken for shallowness or a lack of argument – this is just an effort to present these ideas in a paper of reasonable length. Explaining the ideas of the subject-oriented approach it seems quite natural and adequate to use a first person verbal statements style.

2. Realism and scientific objectivity.

Let us start with the basic assumption of realism - that there is a reality "out there" which has states, properties and behaviour independent of any observer. In this view the real world - or outside realityB - is the source of experience and data when doing scientific observations. The observations and our experience are reported in the natural language and in the form of tables, pictures etc. We denote such description as facts. A fact is most easily described as a piece of exchangeable human experience. When I say: "Things are like this or that", I say so fully convinced that receivers of my message could assure themselves, at least principally, that my statement is correct. One way for them to do so is to gain experience the same way I did. That is, facts are exchangeable experiences that can be made into shareable knowledge. The individual scientist, thus, reports his/her experiences in a paper that contains a precise description of the situation during which his/her experience is established - and could as well be established by another researcher according to his/her opinion. If the original researcher's experience can be repeated by others, then it is proven - not that his/her experience is true - but that his/her experience was exchangeable. This experience is thus made into common scientific knowledge and in this way the individual knowledge is made common property - made an objective fact. However such a use of the term objective is bewildering – consensual is the correct term to use here. In this way various facts regarding a specific phenomenon can be gathered and compiled into models or a set of rules and then visualized in different ways - the experience of an individual researcher turns into a modelC (or rather a set of models). As a first step, this model is strictly private, but in the case where other scientists accept this model (a scientific agreement or consensus) it can turn into a model common to all researchers of that specific scientific area. This view highlights science as a consensual scientific practice depending on a set of basic premises – collected into a paradigm - rather than dogmatic postulations e.g. of an observer-independent reality. Such ideas are clearly advocated by T.S. Kuhn (1968)

We know that the model concept fulfils an important role in this process of inter-subjective information interchange. For that reason it is of utmost importance that the modelling process is clearly understood by researchers of all disciplines and that the rules and assumptions involved in this process are easily grasped and well known but this is unfortunately not always the case. Modelling - or systems modelling - is an activity that requires a conceptual framework within which one operates and for the sake of communication this framework must be alike or at least heavily inspired by the disciplinary frameworks currently in use. Models that represent time-dependent systems behaviour have in general systems theory (GST) and control theory gained a mathematically consistent foundation. The literature on this subject is huge - addressing the question of systems modelling, there are many proposals for such formal frameworksA,B,C,D,E,F,G.

B For the sake of clarity there is a need to distinguish between the outside and the inside reality relative the observer's consciousness.
C In the coming we use the term “model” to indicate both a model and a set of models.
The prevailing realist's approach - descriptivism.

Modelling of systems has its place as a principal tool in all sciences. Models are used for the purpose of description, prediction and control. These are the main domains of discourse within areas such as: systems analysis, systems design, control theory, operations analysis, simulation, management information systems, information systems, decision support systems etc. However since modelling, in its widest sense, is the only means of human communication, this narrow technological view must be widened by the recognition that modelling is essential for any human activity - not only scientific ones - and that modelling is not restricted to mathematical modelling only.

The importance of models and model building as an integral part of scientific inquiry has often been stated:

-- No substantial part of the universe is so simple that it can be grasped and controlled without abstraction. Abstraction consists in replacing a part of the universe under consideration by a model of similar but simpler structure. Models... are thus a central necessity of scientific procedure.

The notation "a part of universe" or equivalent "a part of the real world" is usually denoted as an object or a system. By explicitly representing the knowledge about the components (parts) of a system we specify this experience into human knowledge. This specification can be made in many different ways, and they can all be thought of as models. That is a model is to be regarded as a system's specification developed and expressed in a specific conceptual framework.

There are different definitions of the model conception. Most of them adhere to a description in which the reality is seen as the "real source" mapped onto an abstract model structure. The modelling relation is very often depicted as in fig.1. According to this view the “furniture of reality” (things or objects of reality) are mapped onto models, thereby taking the "outside" reality for granted. We will see this is however a very risky enterprise. Also the "rules of modelling", i.e., the rules of formalization are often also regarded as self-evident or tacitly given by culture (?). An inverse mapping occurs when, after finding a solution, we later interpret the “model behaviour” in terms of corresponding "reality" behaviour.

However the mapping procedure discussed is not isomorphic. The “objects of reality” or the like are rather the source of a homomorphic mapping performed to produce the model - the same way a piece of landscape is portrayed by its map with some bewildering details left out. This homomorphic mapping procedure (abstraction) can be illustrated by inserting a filter in the mapping path as in fig.2 – thereby suggesting that the model is a “fade copy” of some richer original. Still a “fade copy” in many respects can be more useful than the original, since it just catches the relevant aspects of the phenomenon in question. This attitude of modelling we call descriptivism or representationalism.

We can use this view to establish one fact: In the modelling relation the original - the phenomenon under consideration itself “B” - is certainly no model. That is to say, a model “A” is some sort of a "copy" that is separated (or distinct) from the original “B” in some respect - and this fundamental feature is also the essence of (theoretical) abstraction.

Systems modelling and real worldviews.

In this classical realist’s view (dualism) the phenomena of the world are classified into the categories concrete and abstract and the word object is reserved to denote concrete physical phenomenon (the furniture of the world), i.e., substantial things or a limited amount of matter. The word concept denotes an abstract phenomenon. Sometimes the area of investigation or phenomenon of interest cannot be stated as a definite and clearly defined object in the physical sense of the word. In
This case we use the notion *area* to designate a part of the world - in order to delimit "the scope of interest", the "domain of analysis" alternatively the universe of discourse (UoD). This *area* can be a natural phenomenon (a living cell) or man-made (a factory) or an abstraction (a poem) and so on, but we must remember that this distinction has primarily arisen in the mind of an observer only. For that reason this "area" definition must satisfy another demand. For the use of other researchers (consensus) the description or specification must be done in such a way that anybody can uniquely decide if any phenomenon belongs to a specific area or not.

The area of interest - being a physical object or not - is defined by the observer in terms of a *system domain* and the *environment domain* of a system which are the phenomena that are NOT part of the system domain, but are necessary in order to describe the *systemic properties* of the system domain. The rest of universe is considered of no interest for this particular modelling effort. The term systems domain thus confers the idea of a *system*, which in common parlance is called (objectified into) a *system*. However we must once more emphasize that this domain definition is in the mind of an observer solely - at best guided by some pre-given consensual scientific agreement.

These suggestions are perfectly in line with the formal definitions of scientific ontology\(^1\), and from this source we can add the following: All objects have *properties*. The objects are "known" by us only through their *properties* and properties are often represented in terms of *attributes*. An object can and usually has more properties than attributes, because we normally do not know some of these properties. Though a known property must have at least one attribute representing it.

To gather together the strands of the *state space approach* we observe that some properties are time varying while others are more permanent. Time-varying properties are often used to specify the *states of a system*. The notion of a state and set of properties is often interchangeable, although in natural language they may differ in their interpretation. An attribute can in many respects be thought of as a *variable in a state space description*. In classical thinking a system domain always "contains" an unlimited number of phenomena, each of which can be investigated. Every phenomenon is thought to have a *large number of properties* – some of them unknown - and the known ones can all be assigned different attributes. To restrict the domain of analysis - by mapping the reality onto a "reduced" abstract system (abstraction) - is often a necessity just to be able to proceed at all. This mapping is carried out by specifying objects (entities), attributes, possible attribute values and underlying domains and so on – thus defining the concepts of the UoD, i.e., through objects and structures that in one way or another can be interpreted as conceptual schemata.

This worldview of computer science is certainly compatible with the object-oriented worldview\(^2\) - and as a matter of fact any object can be regarded a *system*. This point of view is also valid in GST and in control theory and the similarities are hinted at in fig 4., which portrays the interaction between the system and the environmental domain. The environment influence the system through the *input variables* and the system influence the environment through the *output variables*. The input variables are anything that affect (pass the border of) the system domain, i.e., controls signals, material flows, disturbances etc. The output variables are those leaving (passing the border of) the system domain, i.e., measurement signals, material flows etc.

Note that the observer of the system domain belongs to the environment domain and very often disturbs the system domain under consideration, sometimes by merely observing it. This situation violates one of the basic principles of classical physics. However this phenomenon is very well known in the social sciences, but under a different name and here it does not violate any of the basic\(^D\) principles. When the object of observation is

\(^D\) This is valid even if these very principles are usually tacitly or intuitively understood.
influenced by the observer one of the basic assumptions of realism is violated, which implies a fundamental principal limit as to the knowledge we can acquire as stated in Heisenberg's principle of uncertainty.

In GST the block diagram is a basic conceptual tool used to functionally illustrate the components of a control system. There are two methods to describe a control system mathematically. A description from “outside”, which is done by means of the transfer function:

\[ y = G(s) u \]

which states how the output varies as a function of the input. The structure of the system is left without consideration and the transfer function block is then treated as a "black box".

The state space approach defines an "inner structure" of the system: the state, which is described by means of a state vector \( x = \{x_1, x_2, x_3, \ldots, x_n\} \).

For a **linear system** is:

\[
\begin{align*}
\frac{dx}{dt} &= Ax + By \\
y &= Cx + Du
\end{align*}
\]

where \( x, u, y \) are state, input and output vectors respectively and in general, functions of time and \( A, B, C, D \) are matrices.

The widespread use of the aforementioned formalisms suggests that the state space approach is the appropriate approach for complete specification formalism of the mathematical modelling of the elements of an independent physical reality. This is a refinement of the Newtonian laws of motion as described by differential equations, cast in a more general and elegant form. This formalism consolidated the mathematical foundations (modelling paradigm) of the mechanical Newtonian paradigm – as such completely causal and deterministic. The limitations of modelling Nature in this mathematical way very soon became apparent - "to set up the equations is one thing, to solve them is quite another"\(^{13}\). The production of exact solutions was often restricted to a few simple situations and regular (paradigmatic) phenomena. To handle these difficulties mathematicians developed two methods to model the natural phenomena encountered in science; the deterministic equations of simple systems (the state space approach) and the statistical equations of thermodynamics (for complex systems). They both featured mainly linear equations. However non-linear equations regularly emerged - most often too difficult to solve – and the general solution to this problem was to accomplish a local linearisation around an assumed state of equilibrium and then solve the linearised equations.

The decisive change during the last three decades has been to recognize that nature is relentlessly non-linear. The exploration of non-linear systems has had a profound impact on science as a whole, and it has forced us to re-evaluate the relationships between the mathematical model and the phenomena it is supposed to describe. Today’s progress is mainly due to the modern computer and its capacity to solve both non-linear equations and to simulate non-linear highly complex phenomena.

Another blow to the classical paradigm occurred when the cyberneticians used GST and introduced the feedback loop when developing 2\(^{nd}\) order cybernetics\(^{14}\) which revealed the importance of self-organization. These ideas spilled over into physics and were developed in the theory of "dissipative structures"\(^{15}\). This theory deals with open systems far from equilibrium that are characterized by non-linear equations. Here the mathematicians showed that even simple (non-complex) systems were able to display chaotic behaviour – and we witnessed the birth of the chaos theory.

The new mathematics of complexity accompanied by the concept of self-organization launched the idea that the pattern of organization of a system is the clue to understanding its complexity – and the concept of complexity. However the one-sided object-oriented approach was never called into question in spite of the emergence of quantum mechanics in the early 1920’s.

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**Figure 5**

\[ u \rightarrow G(s) \rightarrow y \]
At the same time cybernetics and social systems theory started to be interested in self-organization and self-referential systems pointing out the essence of the observer's role when defining a system. In a similar way researchers in biology expressed dissatisfaction with the classical approach – it was not able to capture the essence of life – a question that was of great interest to von Neumann and spilled rapidly over into computer science. These early indications were further emphasized by the cognitive sciences interest in perception, cognition and consciousness and this interest has revealed a set of phenomena, which cannot possibly be explained within the realist’s framework in its classical sense.

**Critique of the classical view.**

We have pointed out previously that the prevailing object-oriented approach (the realist’s approach) being presented - has some serious shortcomings because some aspects of the observer’s function are being neglected. Another, even riskier undertaking, with this approach, is, the counter-intuitive but nevertheless, questionable definition of an observer-independent reality, which has resulted in a “world definition”, made from “outside” the living mind being part of the Newtonian paradigm.

Let us first observe that traditional modelling is performed from a 2nd order observer's point of view, unfortunately disregarding the intermediate link of the observer C (the mediating subject).

It is fairly easy to understand that what is primarily modelled in this situation is not any "outside" furniture of reality but instead the percepts arising in the mind of an observer (the I-reality). It is also important to realize that this process is not a direct one-step mapping of some "outside" reality into a model but must rather be seen as a two-step procedure:

1) - A "projection" of an object of reality into the mind of the scientist - as a percept. A perceptual path or path of perception.

2) - The explication (construction) of this percept - into a model (system). A conceptual path – or path of formalization.

To circumvent some of the shortcomings of the more traditional model definitions, we can use a more functional model definition as proposed by M. Minsky:

To an observer B, an object A* is a model of an object A to the extent B can use A* to answer questions that interest him about A.

This view regards any model as a database (DB) or knowledge base (KB) and definitely takes the observer of the system into consideration, which is essential. Furthermore this definition mentions a purpose of the observer and such a purpose certainly has a heavy influence on the outcome of the modelling process. This definition also underlines the fact that every model is associated with and restricted by the way it is presented (explicated or laid out). The percept formed in the mind of the system viewer (the I-reality) is, as a rule, obviously much richer but the resulting model and is usually termed a mental re-presentation of the objects of reality or the system under consideration. This view is indeed misleading and we will argue later that this is certainly not a re-presentation.

Minsky’s definition also highlights that any system (specification) or model is an abstraction. This is in contrast to the normal use of the term system - “a concept that captures a part of the real world”
and tacitly suggests that this act of capturing could be accomplished “objectively” in some sense. This is a misconception. The act of isolating an area of the UoD into an “object (intent) of specification” is, definitely, in a sense an act of “object-ivation” – however the term “objective knowledge” is not at all meant to specify some knowledge that has come up by objectivation in this sense. By objective knowledge we mean, rather, scientific knowledge and one of the dictates of classical science (at least natural) is to take on the role of the detached observer. In this scientific role our objects of observation are all “outside” – nothing more nothing less.

This situation must not be confused by the fact that we in science try to wash away subjective (personal) elements to gain a consensual agreement on the objects of the UoD. We must hold on to the idea that any system specification is an abstraction – and in the first stage very private. This contrasts heavily with the idea of a physical object for instance, e.g. a chair and a car, which is never thought of as an abstraction. This is also a serious misconception – for an interesting discussion about this issue see Eddington[17].

The subject-oriented approach claims that every system and object definition is at first subjective and is always defined relative to some observer - a point of view that has hitherto been severely muddled by the realist’s rigid world definition – which is also perfectly unnecessary as we will soon see. To undermine the idea of the traditional view regarding the reality as pre-given (given beforehand or real) and observer-independent it is advisable to try to avoid the first (perceptual) step in the modelling process as classically envisioned and concentrate on the second one – the very formalization. In other words this means to become involved in the modelling of ideas.

The modelling of ideas.

Let us contemplate the conception of a “point”. We ask what comes to mind when a human meets the “point” conception? The idea of a point – is a probable “explanation”. This idea is abstract - since the generative process behind the idea of the “point” does not involve the sensesE. I am convinced that every normal human being can form the idea of a “point” and contemplate this abstract idea just the way I do it.

I believe this - to the point of certainty - but how do I know for certain? In a communicative context I could very well ask the person in question: "Describe a point, please!" or ask him to indicate a “point”. However until the day we have the means to communicate more directly with the content of human consciousness – we certainly have no other option.

I ask C: “What is a point?” C maybe answers: “A point is a dot that does not occupy any space” - an utterance. The source of this utterance is C’s idea – for the moment totally disconnected to any perceptual input - and in order to establish consensus we, as receivers, must first be able to interpret the utterance and also agree on it. No agreement – no consensus and no understanding. C’s utterance is an action namely the “effort to utter” - and the result thereof is a statement – or a verbal model. Since abstract phenomena are space-less (non-perceptible) we might need a clearer explanation. Maybe C says: "A very small dot" – another model and action but a closer explanation may need further actions. This could result in a drawn dot – i.e., the model point. Another option for C is to hit the “point-marked” key on a computer’s keyboard – clearly an action or C could point to a grain of sand and say: "This is close to a point" - another iconic model. Here we observe, in communication, the natural use of a set of cooperative models.

There are many ways to communicate the idea of a “point” but, common to all is that they cannot be done without an action - and this results in the model. Here we find a new characterization of model – however all actions are not models. However the inverse always applies – every model is the result of an action or activity. This idea can be made into a principle; we cannot break the introvert world of ideas without outward actions. The resulting manifestation of this act is a “physical

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E In spite of this, we can probably not build up the relevant knowledge to properly apprehend the conception of a point without the use of our senses (our experience) - the immediate reaction to the idea when provoked does not involve the use of senses.
construct” – a model (or a set of models). This model is a first stage, nothing more than a private model (a person’s sign or reminder) of the original idea - a mental construct.

Mostly the phenomena of “reality” are envisioned as explicitly presented in a single model only - this is an over-simplification. Here, as in practice, we observe the obvious need for many different models to frame a certain presented idea – such an attitude is called multi-facetted modelling\(^{18}\). We then, generally, use a row of different models in parallel for the purpose of presenting an idea even in science – even if seldom recognized. For instance iconic, verbal, mathematical, logical, conceptual models etc. are laid out together - each one maybe catching different aspects of the idea lying behind it. In fact a verbal model – a spoken or written statement or row of statements always accompanies a human model. Single models rely heavily on the consensual understanding exerted by the profound training in a scientific paradigm - so human modelling efforts are always and have always been multi-facetted in that respect.

The categorization of models
When it comes to categorizing models we can readily make use of Pierce's sign trichotomy\(^{19}\) - symbols (linked to the original by cultural conventions), icons (linked by similarity) and indices (linked physically). In this view symbolic models are structures based mainly on the concatenation of the common cultural symbols called characters or letters. A character is an element \(a_i\) drawn from an alphabet \(T = \{a_1, a_2, a_3,\ldots,a_n\}\) - a set of marks chosen according to some cultural or scientific convention. The symbols of our language are the most obvious example. \(T = \{0,1\}\) - the binary alphabet - is the minimal useful set. Among the group of symbolic models we find the verbal model (the written or spoken natural language), the mathematical model and other formalized languages, logic, predicate logic, the conceptual model and many others.

The iconic models are based on a visual similarity (models focusing on a functional similarity are called analogical). The pencil and paper, which was the useful output device of Newton's mathematics, has been superseded nowadays by the computer screen, which has extraordinary graphical possibilities. We will experience an explosion of the use of such facilities. Among the iconic models we find small-scale models of different kinds, the map, the photo, the mannequin, works of art and so on.

The modelling framework – a language.
At the moment the introvert-breaking act of physical construction has become a habit – the modeller/constructor has established a modelling framework (or a language) - still of strictly personal use. In this situation the basic concepts of the model are familiar to the constructor (i.e., induces interpretable percepts in its conscious experience), which are therefore the signs upon which the constructor can erect useful interpretations.

The purpose of this act of description is not only inter-subjective communication, since we recognize the need for auto-communication – a physical act intended to "shape our own intellectual understanding" of concepts or ideas. We often make use of such auto-communicational acts involving physical sign production in order to "sharpen our understanding" of a concept – for instance when sketching ideas in a notebook or the like - a process of chiselling out useful concepts from fuzzy ideas.

How do we proceed in order to communicate our ideas to our fellow beings? Since telepathy is not possible, there is no other option but to teach fellow beings to become outside interpreters by learning rules of the modelling framework and how to interpret different concepts. This learning process must establish a connection between the ideas of the model constructor and the personal ideas of the learner. That is to say, assuming that the learner carries the idea of “a point” in their imagination – the eventual “model ink dot” has to be connected to this very “point idea”. Thus the physical appearance of my construction – the model point – must in time act as a reliable trigger (provocation) for the “point
idea” of the learner. A sketch, drawing, mathematical or another model has precisely that function – to trigger the appropriate interpretation procedures within the receiver. The works of Piaget suggests such development of the child’s notion of an "object".

In due course we must include a whole scientific discipline or culture in this act of education. As the end result, we will, at best, have a modelling framework (a language or a set of cultural conventions), which will serve as a tool of inter-subjective communication and form the basis of inter-subjective understanding, i.e., a language. In this context I use the terms language and models in their widest possible sense - including icons, drawings, aesthetic texts, music, tactile communication etc. All frameworks of modelling are communication tools in that respect and they all make use of some medium able to present sensory stimuli to the receiver. Multimedia presentations are the result of multifaceted modelling in that sense. This modelling framework becomes an essential part of the scientific paradigm.

Science has been regarded as having superior building modelling frameworks - take mathematics for example – but it certainly comes to the very definition of concepts and rules used to build up the modelling framework in question to claim any form of superiority. Science clearly has no right to claim superiority merely in terms of some diffuse “objectivity” claim. Some experience – tacit knowledge - is impossible to express in the form of a model - since this experience by definition is impossible to conceptualise. In this respect science has a lot to learn from art for instance the taste of a wine comes close to being such an attribute. Another situation is when we deal with unconscious human experience - which is generally mediated by hints and unconscious gestures. By acting and living together people can exchange tacit knowledge and thus get involved in non-formalized communication. These are “languages” with very vague symbols and lacking a known syntax – still containing semantics to the initiated and clearly such knowledge cannot be acquired from a book. We often refer to such knowledge by the term's intuition and the feeling of fingertips. There is large amount of experiential phenomena, which we are, at present, totally unable to frame within a working scientific modelling framework and this situation emphasizes the need for both a multi-modelling framework and the use of even "non-scientific" approaches when we try to frame scientific phenomena.

To stress what is said we notice that the scientific “idea of a point” is not entirely caught in the above-mentioned constructive acts, as we also consider a point to be a mathematical abstraction – or more closely stated a geometrical one. Mathematics is considered a game that can be played without any regard to “reality” - but nevertheless the idea of a point evidently bears on ”the experience of living” – an analogy. In this context a “point” has another interpretation that must be caught. A point has no extension, no structure and is consequently indivisible - and its prime function is reference, i.e., serves as a point of reference in space-time. It defines location in a space-time-continuum and as such an extension of man’s index finger or an anchor point of the presumed “things of reality”.

This brings us to the other central question of this paper - if there really are any such predefined objective “things”- and if so - could we intellectually grasp any essence contained in these? In the case of a mathematical “point” of course there is not much to grasp - since such a point is in fact almost a total abstraction - a “physical” object with all its inherent qualities or properties peeled off.

What is reality?
In most interpretations Bell’s theorem shows that quantum physics is incompatible with the proposition that measurements discover some unknown but pre-existing reality. This idea is most clearly pronounced in the so-called “Copenhagen interpretation” and in the writings of post-
Wittgensteinian philosophers such as R.Rorty and J.A. Wheeler, the latter also raises the question as to whether reality is a great machine or depends on “an idea so obvious that it is not obvious?”

The subject-oriented approach gives pre-eminence to this suggestion and we start out with the tentative answer that “reality” is given when we contemplate the subset of all sensations that we do not consider to be part of ideas, dreams, hallucinations etc. We say that such sensations come from “reality” – and the impressions formed by such sensations - percepts - are in a sense more “real” than our dreams and the like. The decisive quality we are talking about in that respect is permanence. Thus we assume today’s Eiffel tower is also tomorrow’s Eiffel tower both in its appearance and meaning.

Conscious experience is then intellectually built up as an ordered set of impressions – percepts (“coming from reality”) and non-percepts (like feelings, dreams, hallucinations etc.) A closer investigation reveals that the phenomenon we call “reality” is the subset of sensations and impressions we classify as “real” by scientific investigation. Physics is principally the judge of what is “real” or not – but the elements of “reality” are nowadays not necessarily classified as material. A complication however is that the physicist’s refuse to specify what is meant by the term “real” – instead they “float” this very definition obviously to protect the realist philosophy – expanding the “protective belt of the hard core of realism” using the terminology of Lakatos.

Let me rename this “outside” reality as the “out-there-ness” and make a clear distinction between this and another more vivid and close at hand reality – the mind phenomena or the “inside reality” (I-reality). The latter is the colourful and vivid apparition (the process) emerging in our conscious experience when watching the “out-there-ness”. The very question is now, what is the relation between these two realities? And which one (if any) do we refer to when we use the single term reality? My claim is that the only phenomenon worthy of that denomination is the I-reality – and further that this very personal and private impression is the only sign we as living beings have of the presumed “out-there-ness”.

As already pointed out I-reality is not even a homomorphic mapping of something “out there”. No – not at all! We shall, even at this stage, propose that this is just a mental model – a mind’s construction built on the clues from outside and this model construction reveals more about the workings of our brain and mind than anything about some “physical” features of the “out-there-ness”.

The reason is that the prevailing object-oriented approach to science tacitly rests on a daring hypothesis - the pre-existence of a "reality" which has definite properties, whether or not it is observed by someone. To its existence, I can agree – thereby rejecting solipsism – but this only amounts to a feasible definition of existence. My claim is that this presumed “out-there-ness” couldn’t rightfully be assigned states and properties that are observer-independent. The very moment we embark on that route we create confusion – the realist’s confusion. In other words here we continue the works of Einstein by now relativising the concept of state and property. However, states and properties may be assigned to the I-reality – which is a sense clarifies a Bohr’s claim that objects of our experiments receive states and properties just by the very act of measurement. When we also grant that even the objects of observation emerge at the very time of their observation – we can understand why von Neumann refused so intensely to accept the interpretation of a “collapsing wave function”. The situation is fairly simple when you are on this track: If we wipe away all observers then there is no I-reality to which properties and states can be assigned – there are no objects to be seen by anybody. Thus the notion of I-reality makes sense only in the presence of an observer – exactly in the same way that any dream is in need of a dreamer. How is it then possible to speak about observer-independent properties of reality or even an observer-independent reality? We have been caught in the trap of naivety – the “out-there-ness” very probably exists – in the sense of the “clues” of perception, which echoes the words of Berkeley’s “to be seen is to be perceived” but no features can consistently be assigned to this “out-there-ness”. The colourful rich world is the sum of our impressions – and constitutes our consciousness. There is no knowledge “out there” - scientific knowledge is “in here” in my mind as part of my consciousness.

To avoid the "trap of realism" we simply avoid postulating some "outside" reality, for the simple reason that we have neither any proof of its existence (just a naïve imagination) nor the slightest idea

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F The Peirce’s indices -i.e., "physically" connected
of its essence. Therefore let us mark a phenomenon (object) in the “out-there-ness” by a question mark (?). The woman in fig. 10 is an observer looking at the “out-there-ness” – and here is the crucial point. The objects of “out-there-ness” are actually unseen – all that is “received” \( G \) by the observer are the clues from outside.

Let us say that she sees a tree. Where is the tree - in the “out-there-ness”? No, the tree (the object) emerges in her conscious experience and the only sign we have about this presumed “existence” is her spoken words “I see a tree”. When I look at the same question mark (?) I also see a tree. But how can I be sure that her percept is similar to mine? I simply cannot - and what is the term “similar” supposed to mean in such a context?

So the only sign I have of her conscious experience is her utterance “I see a tree” – the model - and this act of communication is due to the spoken language. To utter words (assemble) from a given language, or draw symbols (assemble) from a given graphical language or the like is an outward action of an observer/actor and this is the only means to communicate different ideas or concepts to other consciousnesses. Such models are laid out in different modelling frameworks (different languages) and the end product – the model – is a re-presentation of the original presentation (percept) in the conscious experience of the observer/knower. Human presentation does not even have to involve any “out-there-ness”, as for instance when an artist paints the experience of a dreadful dream.

In order to be useful the result of this outward action - the model - has to be "caught in the fly" or laid out (permanent-ed) onto some medium of permanence \( H \) thereby establishing a memory function - and thus suggesting that communication and memorization \( ^{29} \) is one and the same process. Even the “ether” can be regarded as such a medium and the electromagnetic light wave then becomes the “printed matter” stored in such a medium. The medium in use serves as a base of data and the receiver of the message delivered by this medium can be another consciousness (interpersonal communication) or the self (autocommunication \( ^{30} \)). In this situation we must be careful to take into consideration the permanence factor of the medium used.

Thus any model or part of a model (sign, symbol or representation) thereof must be considered an observers/actors action. The modelling path is thus very dependent on human constructive fantasy and has always been regarded as constructive, also in the classical sense of modelling. The spoken language and mathematics are the outstanding representatives indicating this state of affairs.

The need of activity from the receiving part is also obvious – firstly to observe the model (or eventually go and look for it) and secondly to interpret it. Maybe the receiver also has to establish a link of inter-active communication in order to reach the very goal of social communication – consensual understanding. We understand that behind this instantaneous act of interpretation is something considerably more comprehensive – how to learn the art of interpretation – which is so essential for both the physical and social survival of the individual.

Observation and measurement:

Vision is by far the most important human observation capacity and is the perceptual capacity, which has been most investigated \( ^{31} \) and is best understood. Evidently we must also look at measurement from a modelling perspective, since most people mistakenly attribute a considerable difference between these acts. This is not correct – to measure is to observe – nothing more or less – however measurements are in some sense more stable. For an observer to measure some “property” it firstly has to be “separated” or “abstracted” from the phenomenon under consideration. Then the sensory impression has to be assigned a numerical value according to some scale and standard unit of measurement and presented as such. An observer performs these two steps in parallel. This is a

\[ G \] However “receive” is also a questionable term

\[ H \] At least semi-permanence
modelling task - not an easy one – but nevertheless a plain **modelling effort**. For instance the length of an object is measured by separating the *spatial extension* (foreground) in some direction from the *rest of the percept* (background) and then a *length measure* is assigned to it by the comparison with the *standard meter*. Such a "naked eye" measurement is highly "subjective" and uncertain and therefore the natural sciences depend on measuring devices and sticks.

![Figure 11](image)

To construct a measuring device we have to find a "physical" phenomenon that separates the "property" (foreground) from the rest of the phenomenon (background). Then to measure\(^1\) the "intensity of the corresponding sense impression" we have to find a measurable correlated "physical" phenomenon. Once such a device is invented and mechanized, the non-stable human judgement can be replaced by the *output of a designated, warranted measuring device*. Once, we as inventors have found the proper "property abstraction" we can depend on this measuring device, which is a *well-defined transducer*. Thus making measurements turns out to be a true mapping procedure – the original signal \(S\) is modelled by its output \(f(S)\) in an act of transduction \(S \rightarrow f(S)\) in the mathematical sense. This act of transduction is repeatable to a high degree – this is the crucial point - otherwise the device had not been duly warranted as a measuring device.

Unfortunately the use of measuring devices does not "objectivise" the measurement process – as most often thought. A measuring device can be used to *extend the senses of man* – to make him see "invisible" phenomena – but this must not be confused with "objectivity". A measuring device is, because of its mechanistic/electronic features, more *stable and repeatable than a human being*. It is also more reliable than a human observer in another sense – since it is invented and tested by a certified engineer – we might call him *an expert observer*. In the same way we can recognize other expert observers – we give some of them the title *experts* or professors. This state of affairs must not be confused with "objectivity" in the sense of an observer-independent reality.

When we compare fig. 10 and fig. 11 we realize that the *observation of a measuring device* is nothing more and less than a simple 2nd order observation. The only difference - but a crucial one - is that the living observer (the constructor) has constructive power and the ability to self-adjust, abilities that are totally missing in the classical measuring device (the transducer).

**Observation is decision.**

In the light of what has been said the realist’s conceptions of state, property and object stands out as confused and ill defined - and this is one reason to make use of a subject-oriented approach instead. This latter suggests that objects have no properties except when measured and that "property" is a *quantified* human sensal impression (expressed in bits) outwardly projected onto the object measured. The *essence* of this "property" is nothing more than the biological reaction met with by the peripheral sensors – i.e. it carries no other "qualities” than an *address to the peripheral sensor engaged and a measure in bits* – called the “experienced sensal impact”(quantity) – which is attributed to the sensory signal. From an intellectual point of view this essence is irreducibly self-referential, requiring information about the "address" of the peripheral sensor involved and in consequence mainly a "property" of the observer. What is further behind this sensal impact (the ontological question) is out of the reach of human intellect and knowledge.

Another reason to use the subject-oriented approach is to cut off the infinite regression of observers watching other observers; a fact most clearly pointed out by von Neumann\(^32\). A very reasonable choice is to put our trust in the autonomous unity of the human being and *place the cut at the level of the subject*. In doing so I will claim the essence of observation is *change*\(^33\) - a *mental state transition*; that is, *when your conscious experience undergoes a mental state transition this is the only situation when you observe something* – and this state transition is in turn attributed (or projected outwards) - to something "outside" your conscious experience \(^34\). Here lies a crucial point and most hard-to-
understand feature of the subject-oriented approach - the outward projection - that in a sense closes the circular explanatory loop of causes. This is a process going on unconsciously – the processes occurring in the human brain appear to be located somewhere else (projection) – in some place “outside” the human mind, thus reminding us about the oracular words of Wheeler “an idea so obvious that it is not obvious?”

Here is not the place to further explicate on mental state transitions, and so for the sake of explanation let us agree that a “car” is nothing other than a set of coherent mental state transitions. Schematically the process of observation/projection can now be explicated:

a) Mind “sees” the clues of something – find it to be a car  
b) The I-reality is outward projected  
c) The I-reality “disappears” – was actually never recognized as a local phenomenon

When there are no mental state transitions – then there is no observation – regardless of what has “actually happened outside”. Observation is nothing other than an act of decision – the decision that something has changed in the mind’s conscious experience - and such decisions are made by knower’s. When it comes to observation the observing subject is the decider/knower. As living beings we have to learn to separate prospective harmful state transitions from the harmless ones. Once we have learned our lessons these acts of decisions are quite straightforward, but the amount of learning to reach that state of knowledge will have been comprehensive. From that point of view there is certainly no need for any colourful “out-there-ness” – the I-reality is all that is needed.

Since we do not believe in solipsism (bare mind-spinning) the observed state transition is hypothetically attributed to something coming from the “out-there-ness” or from the bodily "in-there-ness" (feelings and imaginations) - but definitely from "outside" our conscious experience. Thus the momentary classification of a percept is a very private process – and the "objective" features of this process are due to nothing other than our individual skills, which are the result of careful upbringing, education and from previously met experiences - a body of knowledge defining a paradigm.

Perception seemingly consists of events when the so-called “physical world” undresses (reveals itself) and shows bits of information to the individual’s conscious experience. Raw data (nerve impulses) become information inside the interpreter’s consciousness – after the act of interpretation. Consequently bits of information or messages are “stuff” born inside a living consciousness – and which die outside it. No meaning (or substance) can be attributed to such raw data outside a knowing consciousness. In this way the need for the stained classical dualism entirely vanishes - to be replaced by a monistic view - where the presumed inputs of mind are bare data (impulses). This is to say that data lacking the association of interpretation procedures contained in the interpreting mind are just useless data – or garbage and thus non-existent since our brains learn to ignore it.

Raw data emitted by “external objects” then becomes information inside the interpreter’s mind, which is the picture, advocated by the object-oriented view. The idea that the brain adds raw data along the perceptual path on a private basis is from this view merely a twist to try to rescue classical objectivism. How do we tackle the problem of hallucinations showing green Martians coming through the wall, when there is no way for a conscious being to objectively separate “perceptual” data from “non-perceptual”? In this task he or she is certainly directed to clever guesses and in that respect useful guesses are clever guesses – this is the core idea guiding Peirce’s pragmatism.

**Constructive elements.**

The cognitive sciences have clearly indicated that the brain’s function is constructive i.e., there is information in conscious experience that has no correspondence in the “out-there-ness” – according to the collective convention used. This is the first challenge of symbolic modelling. A 3D impression in the figure outwardly projected onto a plain sheet of paper reveals that data are “constructively added”
between the eye and consciousness. Clearly such a constructive functionality cannot be handled by a plain mapping. The blind spot of the eye is also unseen – which also confirms this “filling-in activity” of the human brain. We are also familiar with the optical illusions produced by the Nectar cube, where we are able to choose an interpretation at will. In the literature on psychology and cognitive science there are numerous examples of such phenomena. Such “corrections” are true constructive acts performed by a highly adaptable brain. Here the affirmative differences between descriptivism (transduction) and constructivism (construction) clearly stand out. In both cases raw data are considered removed (to avoid brain-processor overload) – but in the latter case the brain adds information, which seemingly has no sensory counterpart.

However using this process, we are unfortunately still stuck in the object-oriented way of thinking, since the “corrections” performed are just corrections in the object-oriented sense. This inevitable means that we run the risk that every observation contains subjective elements – i.e., that the constructive brain has inserted raw data to complete the information missing according to its own private opinion of the path from the senses to conscious experience. There is certainly no way to eliminate such raw data insertion in the perceptual path until we can observe “directly” by conscious experience. Admitting this state of affairs makes all observations private and the idea of a consistent objective science unveiling the truth based on observation fades. Human observation can at most be true for human beings – which is another argument for the claim that science is a group activity guided by a consensual paradigm.

The subject-oriented approach

According to the subject-oriented view – observation actually works the other way around. Outgoing from acknowledged state transitions in conscious experience our intellect constructs an outward path to a reason in the “out-there-ness”. This view reveals that the “outside world” is epistemologically created from the “inside”. This act is not re-constructional however. This is a process of construction – since epistemologically there is nothing to re-construct. When a group of mental state transitions has proven useful to us we have neurally learnt to project it outwards onto the “out-there-ness” – a path originating in the mental state transition and ending up in the clues of “out-there-ness” – this is the essence of observation in the subject-oriented view. This act of projection is biologically performed to “code” the distance to the object in question. Consequently we see by mind and not by the eye - our consciousness paints a useful “out-there-ness” by projecting the privately experienced internal mental state transitions outwards.

On the other hand, when a mental state transition proves to be useless, we “forget about it” (the brain is adapted to neglect this type of input) and adaptively cease to observe it in future. That is to say, mental state transitions that are of no practical use to a cognitive agent are ignored to the point of disappearance – a process of submergence.

Such an I-reality should not be called a re-presentation, precisely for the reason it has not been presented to anyone else. The correct denomination is a presentation constructed on the basis of clues from outside – and in that respect “mental” models (endo-models) differ from “physical” models (exo-models). “Physical” models of the classical reality are re-presentations of the content of conscious experience – which itself is a percept – i.e., the first and original presentation of the presumed “out-there-ness”.

The next step is to realize that the outward projected model – the I-reality - does not even portray the “out-there-ness” - it is mostly a perceptual construct (the I-reality). The only demand we have on this perceptual construction is that it should allow us to effectively make predictions about the happenings in our environment. As seen from the 2nd order observer’s perspective (the scientist's) the "out-there-ness" is virtually a "black-box" - the output of which is the subject's percept and the input is the subject's action. The I-reality (the image) is the subject's tool to control its outward actions, but the scientist does not see this "image". All the scientist sees is his own I-reality - which includes the subject - but certainly not the subjects I-reality (image).
Let us ask what happens if the subject looks at a phenomenon which is “invisible” - an atom for instance. Since the brain does not produce any perceptual construct (I-reality) in this case, the subject is free to invent an arbitrary model - within the constraints that it must be a good basis for prediction. In that respect anything goes - but needless to say, some models work better than others – or rather some models are useless and therefore discarded.

Since we use models when communicating our experience to other beings it is advisable to use a well-known consensual model and in that respect a model featuring some known everyday phenomenon will be most appropriate, since most human beings have gained an immense experience from the behaviour happenings of everyday phenomena. Such a choice takes advantage of previous common-sense knowledge when exchanging knowledge of the “unknown” model-phenomenon. We have constructed a suitable analogy and in short we make use of analogical thinking and modelling. I claim that this is why the atom is portrayed as a miniature of the solar system, the particle a grain of sand, the electromagnetic wave the billowy surface of the ocean to give some examples.

**The holistic view.**

The I-reality is projected outwards onto the estimated "location" and we as human beings have not the slightest feeling or internal indication of this process of outward projection going on in our own conscious experience. I believe that this is the main reason why intellectual understanding has taken a long time. In this view there are certainly no images in the mind of the observer - just a process going on in its brain but the "feeling" of this process is subjectively “located outside" the mind/brain to find the anchorage (the clues from outside) - this is the projection. This is also the very proof of the "out-there-ness" and non-solipsism, i.e., the usefulness of outside clues. However we have now arrived at this conclusion without the postulation of some reality as presumed in the realist’s paradigm. We must remember, however, that we have only proved the existence − this existence does not include any features. Knowledge arises only in a mind.

We must understand that visual impressions of this view are just bare feelings to be treated at the same level as other human feelings. However we know that this outward projection mechanism has been recognized at the non-perceptual level for many years, for instance in psychology and psychoanalysis - in this case a living being projects his/her own fears and subjective feelings onto the “object” of observation. Let us further explicate on the constructive build-up: The colourful images (I-reality) emerging in a newborn child’s mind are at first highly confusing. The movement of a hand by the child almost accidentally happens to produce, at the same moment, a tactile input. This tactile input becomes the "clue from outside" which is experimentally correlated to the mind’s image. As time goes by, the perceptual impressions that can be successfully (criterion: usefulness) correlated to some tactile impression are established (permanent-ed) in the form of recognizable images (the objects of I-reality). To be of use this "image" must be outwardly projected upon the "clues from outside", thereby defining "something" "outside" consciousness and at the same time defining spatial distance as the measure of the arm’s motor movement. The impressions that cannot be brain-computationally correlated to any permanent phenomenon are useless and are in consequence suppressed by mind/brain in order to avoid cognitive confusion. In this view the colourful images of I-reality are thus used to dress the "invisible clues from outside" producing a vivid and colourful reality (by means of outward projection).

As a consequence the I-reality (image) is the cause of the search for a "clue from outside" and such an outside clue (when found) is the cause of the cognitive establishment of the object. Any object definition is then due to a circular process of mutual casual reinforcement. In such a process we can manage without neither the images of I-reality nor the clues from outside - and this necessitates a holistic approach.
We proposed that the outward projection mechanism explains why the brain-internal processes (the I-reality) appear to reside "outside" consciousness and there become the colourful REALITY - which is superimposed upon the clues from outside (the "out-there-ness"). In that respect reality with its properties is the model of the "out-there-ness" - the clues from outside, which cannot be attributed states or properties or define objects or systems. The colourful REALITY is the result of our nervous tissues reaction to reflected light - of course the bat's REALITY will be entirely "different" because of the difference in its brain structure and the properties of reflected ultra-sound. The properties of REALITY cannot possibly be observer-independent in such a setting. In consequence not even the geometrical properties of I-reality are unaffected by the observer - that is easily realized when we assume an observer having eyes sensitive exclusively to X-rays.

We must conclude that not only the modelling path - is constructive, but also the perceptual path. The human mind constructs it own reality! The modern findings of cognitive science have clearly paved the way for such a view and possible re-orientation. When using the classical object-oriented approach data are constructively added between the eye and the ultimate mind. According to the subject-oriented approach, on the other hand, we find some data in conscious experience that have no "outside explanation" according to the objective consensual agreement in use. In both views this is the result of the doings of a constructive mind/brain – and the prevailing opinion of the mapping procedure performed by the human perceptual system is now in decline. This constructive process along the perceptual path, which cannot be captured by the traditional mapping procedure, is a true challenge to symbolic modelling in all its forms.

Descriptivism turns into constructivism in a shift of paradigm in a true Kuhn40-ian sense. The purpose of science is no longer to portray some “out-there-ness”. The purpose of science is now to explain how we from inside learn to cope with a changing environment in spite of its anonymity and how we construct and make use of the models that make us (and our brains) so extremely successful in our acts of prediction, control and communication.

What happens to the truth and the objective reality?

When an impression (state transition) S occurs in a conscious mind and is outwardly projected onto some privately constructed “outside-the-body-reality” phenomenon then the eventual “truth” of this state transition is wrapped in obscurity – such a decision is actually beyond human capacity. Truth decisions require a reference – but there is nothing to compare the I-reality against, since the structure of the "out-there-ness" cannot justify any such comparison1. With the lack of a system of reference such an absolute decision regarding that matter is impossible unless there is some interference from a deity. Since we believe that there is no God to provide, not necessarily the answer but rather a point of reference, then there is nobody to inform us about such an absolute truth - Kant has already pointed out this state of affairs41. Of course the truth is also hidden to any other living observer - so from this point of view the classical interpretation of truth vanishes. All observers can do is to convince themselves by verifying S by experimentally provoking similar transitions – but this is quite a tedious task. The observer can also check for the occurrence of other mental state transitions that can be intellectually correlated to S as another means of verification (i.e., use other senses). The more evidence of a stable, repeatable and multi-faceted phenomenon lying behind S - the more "real"= reliable S is considered. There is no way the observer – or any observer – can be assured that “he or she is 100 % correct". He/she must believe in their own interpretations skills – or ask for some outside

1 If a comparison was possible - who should perform this comparison when there is only the very subject who "sees" the I-reality?
assistance to verify the probability of the S-occurrence. Here the scientific group that he/she belongs to can come to the rescue – by providing/producing a relative point of reference – thereby establishing a group-consensual truth. Such truth-conception can be extended to embrace the whole community or even all mankind – without losing its relativity – truth relative to a body of knowledge. We suggest rather that the better-adapted pragmatic fit/unfit (or useful/useless) is used to replace the classical truth dichotomy.

The ontological question however remains – the “what is?” question. What is a mental state transition? Assuming that we know this answer we realize the “what is”-question was not about this mental transition but about the outward projected transition – but a little afterthought shows that these are identical – and this projection backfires on us. The world is a myriad of state transitions in my mind – a priverse – once more the by now well known I-reality. In this situation we understand how it is possible to simulate the “physical” universe (or at least a priverse) by a cellular automaton\textsuperscript{42} Plain solipsism? No not necessarily – we can believe in mind-external causes – and do. However we cannot assign some quality to them – qualities are purely mind-internal phenomena. The “what is”-question asks for quality and the only answer we can give is information 0 or 1 – that we can name matter or emptiness or whatever is the name for that matter. Since truth also vanishes the ontological truth vanishes – however this is not the whole story since ontology also vanishes alongside the “what is”-question. To be frank not even the realist’s – assuming their worldview had been correct could have been able to provide any correct answer to this question. Mental state transitions have counterparts in the “out-there-ness” only according to some probability – the more probable the state transition is the more “real” it is considered – but this is all.

Since the ontology disappears there is only way to define an “objective” world. The concept of objective reality must stand for a "reality that can be used as the basis for inter-subjective discussions" i.e., a consensual basis – a collective agreement with a group of scientists. Since the ontology has vanished such a state of consensus could not be attained by reference to some "common outside reality" or pre-given Nature. Instead we must rely on an inter-subjective agreement as to what to regard as objective knowledge – or rather consensual knowledge - as touched upon in sec. 2. The most extreme result is that the "objective reality" reduces to a set of scientific models - which is "unseen" by any single observer and certainly does not refer to any visual impression. This is part of a consensual and structured world-view - a single paradigm adhered to by a scientific community in the Kuhn-ian sense – the latter also providing the rules of the activities called normal science. In the subject-oriented approach the only criterion we put on this paradigmatic set of models and the activities of science is that they are fit for their purpose. What the purpose is however is not a scientific question.

Scientific progress then becomes the procedure of replacing "old" models by fitter ones – some of these replacements cause scientific revolutions – and we understand the history of science parallels the history of human culture. It is desirable that such endeavours are based on the goals of mankind – decided in a democratic or fascistic manner – but this is also a matter for decision.

Observer chains and the ultimate challenge.

There is another challenge waiting for symbolic modelling and even for mankind's view regarding scientific practice. In order to explain the process of perception the constructivistic ideas mentioned in this paper must clearly be incorporated into the framework of cognitive sciences. In this context the scientific observer must intellectually construct a chain of causes from the inside to the outside thereby identifying a chain of observers – or a series of observing agents (fig). Starting from an experienced state transition S in conscious experience the human intellect must invent a casual chain of sub-observers\textsuperscript{17} outgoing from this initial transition S to establish an anchorage in the "out-there-ness". Something like – conscious experience decides a state transition S, which is attributed (connected) to a brain structure transition S\textsubscript{1}. S\textsubscript{1} in turn is the result of a state transition in the optic nerve S\textsubscript{2}. S\textsubscript{2} is the optic nerve transition connected to a retina transition S\textsubscript{3}. S\textsubscript{3} is the retina transition connected to a rod transition S\textsubscript{4}. S\textsubscript{4} is the rod transition connected to a chromophore transition S\textsubscript{5}. S\textsubscript{5} the chromophore transition connected to a photon impact S\textsubscript{6}. S\textsubscript{6} the photon impact is the result of an inter-atomic transition S\textsubscript{7}. S\textsubscript{7} is the result… and so on – in another endless von Neumann “causal chain” – a similar observer hierarchy to that pointed out previously. Now this hierarchy is expanded downwards into a series of sub-observers – and every sub-observer is responsible for a part of the raw
data processing. The physically boundary of the human body occurs at the level S5-S6. Parenthetically this point of view is easily expanded into the ideas of neural networks.

Cognitive scientist physicists claim that this observational path must have a bottom\(^{43,44}\) in such a chain – but from a subject-oriented point of view there is no need for such a bottom nor can it be defined we claim. From an ontological point of view such a search is totally in vain - in spite of today's eager search for the ultimate particle. From a modelling point of view (epistemological) we must pursue such a search until we reach a level where we have developed a workable and communicable model firmly anchored in the “permanence of the out-there-ness” – and after which there is no need to go any further.

For the sake of prediction we can also theoretically even eliminate or re-route all the intermediate steps between conscious experience S and the inter-atomic transition leap S7 and still have a workable causal explanation left – a workable model of the presumed “out-there-ness” in its pragmatic sense. It is clear that the path from S to S7 is a construction outgoing from the transition S, but nevertheless we might think that every step in this chain can be scientifically studied in such a way that we can reconstruct which state transitions are “added or removed” in the object-oriented sense. This is not so – because the pathway from S5 to S also concerns the constructive parts of the pathway of the observer/experimenter him/herself. This pathway makes all his/her observations constructive and no observer can remove the pathway S5 to S by any process of observation - whatsoever. The only way to change or affect this pathway is by means of habituation, training and education. So in this setting the deductive power of observation is lost forever. Well, it was never there – and we must rely on induction - since induction takes into consideration the constructive interference undertaken by our brains. This is not only a challenge to mere symbolic modelling - it is a challenge to the whole of science.

**Conclusions:**

The subject-oriented approach has been suggested before – Socrates was an idealist and the number of defenders is long including Parmeides, Plato, Descartes, Berkeley, Husserl, Mach and others, but the time was obviously not ripe for its acceptance. Has that time now come? The quantum theory has proven very successful but it cannot co-exist with the idea of a pre-existing reality in its classical meaning. This is one reason to relinquish the idea of a pre-existing “classical reality” and accept the suggestion that REALITY emerges from conscious experience. The pieces then start to fall into place – and we can still believe in a single common pre-existing “out-there-ness” – but most are still unknown.

The idea of a pre-existing “out-there-ness” differs from the idea of a pre-existing “classical reality” in one respect – the proposed “out-there-ness” has neither states nor properties. It will “exist” just because we think so – which then becomes the very definition of existence. The literally unseen “out-there-ness” is the anchorage made up by the “clues from outside” – and the emblem of worldly permanence. This is the idea we can carry in our minds – but REALITY is the very model which make clear that the clues belongs to something we call the “outside” of mind.

Bell’s theorem states that the idea of a pre-existing “classical reality” cannot exist alongside the principle of local causes (Einstein locality) and quantum theory. Since we have seen further arguments for that in this paper, let us abandon the idea of a classical reality and redefine the definitions of existence, state and property. Bell’s theorem is of course valid for the proposed “out-there-ness”, but I claim this only pertains when we try to ascribe states and properties to the “out-there-ness”. States and properties can be assigned to the useful and therefore pragmatically true inner REALITY only - here is the misconception.

These ideas support the Copenhagen interpretation that we cannot speak about a state and property until the observation (measurement) in question is actually performed – i.e., states and
properties emerge in the inner REALITY only as the result of observations undertaken in order to visualize the “out-there-ness” on a personal level.

Contrariwise we should regard the “out-there-ness” as being constantly in flux and it can be assigned neither states nor properties – since these are bare observer constructions. Only models can be assigned such features – and REALITY is such a private model.

The need for any REALITY continuum also vanishes in this setting. The measurement process unavoidably takes time - thereby stating that observation by necessity is discrete. So the observable REALITY is by necessity discrete. The idea of a continuum is not a physical law; it is a mere principle stating that the classical reality was thought divisible down to just any level of resolution – and so for the ease of mathematical conceptualization. Quantum physics has proven the limitation of this idea, which now applies to the quantum reality – by virtue of the agreements of quantum physics. On the other hand, in the subject-oriented view the constructed REALITY can be considered divisible down to just any degree of resolution – it is just a matter of fantasy and usefulness.

This paper claims that REALITY is a set of models, but the idea that the classical reality is gone is not a disaster. This is rather how we, in spite of that, manage to construct individual realities that are fitting for control and communication and how we manage to adapt/adjust our brains for this important task – this is a miracle. Education and up-bringing are means to do this – but we must add marketing and disinformation as others. The idea of an inside constructed REALITY is a very promising hypothesis to me - adding another dimension of responsibility thus: When we construct the world we live in by the use of our own power – we are also fully responsibility for this construction and its appearance – the birth of a social existentialism. Mankind is able to create his/her own world, whether it be materialistic, idealistic or psychedelic – a cruel or a good one - the choice is mine, yours – and ours.

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THE SUBJECT-ORIENTED APPROACH TO KNOWLEDGE
AND
THE ROLE OF HUMAN CONSCIOUSNESS.

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Abstract:
Classical science is based on a brittle postulate — that there is one singular pre-given and observer-independent external world underlying human perceptual experience. This postulate is under dispute and considered by many incompatible with quantum physics and the findings of the modern cognitive sciences.

This paper shows such a postulate is firstly perfectly unnecessary and should for that reason be abandoned – a scientific principle already advocated by Newton. Secondly, we will advocate that a common universe in its classical sense cannot be described either consistently and completely or objectively by any observer and for that reason such an idea must be abandoned. This is a shocking point of view but nevertheless the postulate of realism appears most of all to be a vain attempt to rescue some self-assumed “objectivity” of science. This approach has led science seriously astray and has hampered a sound understanding of the human learning process, the cognitive adaptability of mind and the role of the external reality in this context.

This paper will point out the principal inconsistency imbedded in the prevailing classical approach and at the same time come to the rescue of science through a suggestion to give up the misleading realist’s postulate. By making use of the imperative subject-oriented approach we will, instead, come out with an entirely new understanding of the so-called external world and its role in the common scientific discourse. At the same time we must let go of the idea of an accessible real-world truth for a purely pragmatic comprehension of science.

Introduction:
The main goal of this paper is to present some evidence suggesting that the prevailing paradigm of classical science is partly a misunderstanding. This has hampered a sound understanding of man’s relation to reality and misleadingly banned the social sciences and consciousness studies from serious scientific discourse. This state of affairs has luckily not severely affected the successful development of science, and my claim is that this has mainly to do with the classical methodology as practised today rather than a sound theoretical understanding of the foundation of science. However today’s challenges in biology, quantum physics and consciousness studies among others calls for a radical reorientation.

The paper is in two parts: In part A the shortcomings of the classical scientific approach will be examined. Part B will present the only other alternative – the subject-oriented approach to scientific knowledge – that will come to the rescue of science. In this view we say farewell to Cartesian dualism in favour of mental monism – the price to pay is the loss of the real-world truth as a decision instrument - that is very affordable since this idea was an illusion anyhow.

PART A:
1. The problem of observation
Observation is an important engagement in science and general decision-making. Observations are the raw data fed into our models and decision procedures when we try to predict what is to come, whether we are trying to control industrial processes, anticipate economic market fluctuations or just adjust to changes in the daily environment in our struggle to survive. There is overwhelming evidence
that most living organisms possess the capacity to construct and maintain internal representations (models) of their environments.

To use a model is very much like feeding a set of given premises into a "black box" (an algorithm representing the model), and as output receiving a set of conclusions as the answer. For instance, given the premise "There is a tiger at a distance of 50 yards" a practical black box model could output the conclusion "Hide! " and whether this model is implemented in a brain or a computer is irrelevant. A model of the environment is used during this act of prediction and some good models are, in a way, comparable to good computer software because one can buy them in any store and learn how to use them for one's own purpose. Other models must be developed by one's own efforts by trial and error. Education and practical learning are the way to develop useful internal models and a great deal of time during our upbringing and education was involved in these activities.

To human beings vision is the most important input channel of data. Vision seems effortless and obvious. We simply open up our eyes and observe the surrounding world. With a passing glance we perceive the shape of complex objects — at least we think we do — and we can do this whether those percepts are familiar to us or not. However, this apparent ease and directness is highly deceptive. It has now kept mainstream science on an uncertain track for thousands of years. The reason is that observation is a strictly private undertaking, which is incompatible with the requirements of "objective" description (modeling) as prescribed by classical science.

The crack in the armour came in the 1920's when physicists researching quantum physics started to investigate the assumptions underlying human observation and later in the 1950's when the science of cybernetics became interested in 2nd order observation. The results are thought provoking — since the conclusions were that objective perception is impossible and objective observation in its classical sense is a rather uncertain undertaking in spite of its frequent use in classical scientific practice.

Unfortunately this crack did not stop people from continuing to pretend to be involved in the "objective" observation based on the bare bones of perceptual experience. For others the more elaborate procedures of physical measurement guaranteed the "objectivity" of observation in some way or another. This is not so, unfortunately, but since objectivity was regarded as the decisive feature when involved in science, scientists nevertheless clung to it uncritically despite warnings such as:

> The stubborn fact is that conscious experience or awareness is directly accessible only to the subject having that experience, and not to an external observer. Consequently, only an introspective report by the subject can have primary validity as an operational measure of a subjective experience. The 'transmission' of an experience by a subject to an external observer can, of course, involve distortions and inaccuracies. Indeed there can be no absolute certainty (objectively demonstrable by externally observable events) about the validity of the report (Libet, 1987, p.97).

Very few realized the route to an objective - or better consensual – science, for that reason, must go via the strict private and personal perceptual experience obtained during measurement and observation. To understand this let us take a closer look at the delicate situation of the human observer.

2. The primacy of subjectivity.

First, a distinction: An observation can be the result of a circumstantial procedure performed under laboratory-like conditions or a one-step (direct) human impression that we normally call a percept, illusion, hallucination, thought or the like. The latter will be called a mind imprint and in case the imprints are classified as coming from "outside", that is, with the involvement of the human's sense organ — we call them percepts and the result of human perception. Fig. 1 frames the percept which arises or is generated by mind when watching an "outside" entity called a "car", is normally called a direct or 1st order observation. What appears is just the "direct image" of the "car". The subject/observer does not appear anywhere in this percept.
Fig. 2 is the percept "generated by mind" when watching an observer C looking at a similar "car". This situation is called 2nd order observation and I, in this role, called a super-observer\(^1\) (an observer observing an observer) and do not appear in the figure. So in any percept (or rather the reproduction thereof) the perceiver in question is always hidden — and any attempt to visualize the perceiver must necessarily involve a super-observer at a higher level of observation. In this way we can develop an endless recursion of observers, every super-observer watching an observer at a lower level of observation. Unless such a recursion is not broken at some specified level it will become fatal — as von Neumann has already pointed out.

Fig. 2 also portrays the desired situation when doing science — the detached scientific observer. The object of study must be located fully "outside" the scientific observer in question and this situation has been considered highly desirable since the time of Galileo. Of course this situation also pertains when we as scientists try to investigate the process of observation. In fig. 1 the car is "outside" the observer — as are the "entities" involved in process of observation as in fig. 2.

The dictum is: Science must be objective, which in one sense means, that the entity observed must be independent of the properties of the watching observer. Unfortunately the term “objective” has several interpretations. In this paper the term objective will be used in the following sense: Any observed (described or modeled) entity or system that is independent of the features of the individual observer (describer) is said to be objective – otherwise subjective. Most often a secured objectivity is thought achieved when the observer - or rather the observation mechanism - is situated physically "outside" the system studied. This situation is most often found in the natural sciences. However we shall soon see that scientific objectivity does not follow from "outside-ness" alone. The study of consciousness and other “inner” phenomena reverses the picture radically, since here it is impossible to be physically “outside” one’s own brain/mind. For that reason introspection has always been considered an uncertain and unscientific endeavour and was banned from scientific practice for many decades during the 20th century.

Let us return to fig. 1 and 2 and the process of observation. The question to be answered in this situation is: When C and I look\(^2\) at the "same" car-entity, what is the relation between my and C's percept? The obvious commonsense answer is that they are "similar", which unfortunately is a rushed conclusion and a serious mistake. We must clearly understand that the "image" of the car framed in figure 2 is just a part of your (and my)\(^3\) percept and nothing else as is the "image" of the female observer C. Just your (and my) percept - as a matter of fact there is nothing indicated in fig. 2 that could be related to C's mind and we can in fact only guess at the percept "generated" by C's brain. (Note that fig. 2 deceptively suggests the “car” to be C’s image.) At best we can get together in a conversation with C and try to find out what is "in the mind" of C. This is in fact the closest we can come! When we reject telepathic communication as an alternative, there is no other means to access the percept "generated" by C’s brain, and in this situation we cannot possibly find out what is the "look" of the car as seen by C.

So there is an urgent need to correct the misleading fig. 2 into fig. 3 and remember that the image of the “car” is the “image” in your (or my) mind and nothing else. In doing so we notice that when using the usual scientific objective approach the entity under consideration, i.e., C's percept — is not even accessible to the investigator. The conclusion is obvious: Also as scientific observers we are heavily caught in the primacy of subjectivity — perception is out of necessity a subjective (private) endeavour. The examination and description of the process of perception cannot possibly be done from "outside", i.e., objectively.

\(^1\) the term meta-observer is also used

\(^2\) we assume that C and I together in one way or another can "prepare the experiment" i.e., work out that we look at the "same" location simultaneously

\(^3\) even a direct comparison of your and my percept is impossible
So we have met a situation where the normal scientific methodology is useless, instead begging for
the application of the dismissed subjective approach. We must ask here whether an objective science
in its classical sense is even possible or maybe we must apply the interpretation that even if a complete
and consistent description (in its formal sense) is impossible, it is still possible to produce a good
approximate and useful scientific description? Scientific practice has shown the expediency of the
latter suggestion but we will see that it is worthwhile to examine the situation more closely in order to
come to grips with the process of scientific observation.

We understand that science has two options to keep “objectivity” in this situation:
1) To bring back the situation of fig. 2 by postulating the validity of some sort of perceptual
similarity, i.e., that the "look of the car" (and the outside entities of reality) are independent of the
individual perceiver. This is the path advocated by scientific realism.

2) To admit the primacy of subjectivity, i.e., to accept the troublesome situation depicted in fig.3,
and to try and adjust our scientific reasoning accordingly. This way will be advocated under the
so-called subject-oriented approach to knowledge.

Considering the alternatives one understand that the first alternative is both unwarranted and rather
risky and in the second, one cannot at a first glance understand how observations made on a strictly
private (individual) basis can help us to solve the problem of “objectivity” of science. However it
will be shown that we are able to find a successful way out of this dilemma.

3. The classical object-oriented approach.

The first alternative is the choice made by the classical object-oriented approach to science
(realism), which diligently makes use of the realist's postulate, i.e., that there is human experience
that is independent of our perceptions of it. We say that observation and experiments disclose some
unknown but pre-existing reality. The embarrassing fact that C's percept is inaccessible to me as an
observing scientist is covered up behind the realist's postulate – since observation is observer-
independent the “look of the car” is observer-independent. It is worth noting that this postulation is
rather strong since it tacitly implies that the entities of reality (the things) also possess certain states
and properties that are observer-independent. The realist's postulate of course offers a solution to
the problem we face and one suspects that this is the main reason for its undiscerning use. However
this postulate could very well be the presumptuous move that once led science astray. Therefore we
will, in the following, refrain from this risky move – to find out that such a move is both misleading
and perfectly unnecessary. This is in fact the root of scientific dualism as espoused by Descartes.

This might also shed some light on the ongoing quest for a quantum reality, which is clearly a
reminiscence of the prevailing realistic idea (realism) in the history4 of science. The rise of quantum
mechanics has made us doubt the usefulness of the realist's approach and has caused a considerable
debate during the 20th century. So what we really want to call into question is the validity and
necessity of the realist's postulate and what consequences this move has had for scientific knowledge
and methodology under present circumstances. In doing so we are heavily supported by the theory of
quantum physics, which in most interpretations, is rendered incompatible with the realist's postulate.
Support is also given by the findings of the modern cognitive sciences that most insistently claim that
the process of perception is theory-laden, i.e., very dependent on the theories embraced by the
observer in question.

4 Quantum theory and the realist's position are probably incompatible.

Quantum theory is our most up-to-date theory of the physical world and it has flawlessly been
successful in describing the physical world at most levels of description. There is no dispute about the
usefulness of the theory since it has been exposed to numerous falsification attempts and passed every
test. Physicists can perform experiments producing results of exceptional accuracy and correctly
predict the results of these experiments by the use of quantum theory but they nevertheless disagree
profoundly about what is the underlying reality. Quantum physics — reputedly a subjective theory
(most often tacitly) — accurately describes the behaviour of the atom for which its use was originally

4 sometimes relieved by more idealistic ideas (idealism)
intended. In most interpretations, unfortunately, the classical reality conception in form of the clarity of a tangible reality disappeared. As once stated by Heisenberg:

"The conception of the objective reality of the elementary particles has evaporated in a curious way, not into the fog of some new, obscure way, or not yet understood reality concept, but into the clarity of a [quantum] mathematics." (Heisenberg, 1958)

Mathematically, quantum physics treats the atom as a wave of possibilities and not as an actual entity in its classical sense. A commonly held view is that this pertains as long as it is not observed, but, whenever it is looked at, it "materializes" into a row of data — an event mentioned as the "collapse of the wave function" or the "quantum leap\(^5\)". The controversial question then becomes, does this quantum leap takes place in some "outside" reality or just in the mind of the observing physicist. There are many suggestions about the interpretation of quantum theory and its relation to physical reality, which can be found in much of the plentiful literature (Herbert, 1985) on the subject. Most of them suggest an undefined involvement of human consciousness during the process of the observation, as H. Stapp (1993 p.3) puts it "... and then a Miracle Occurs" and they also suggest a reinterpretation of the classical concept of reality, in some cases quite a radical one.

In 1957 Bell’s theorem (Clauser and Shimany, 1978) showed us that quantum physics is incompatible with the proposition that measurements discover some unknown but pre-existing reality. Moreover, this theorem stated that the idea of a pre-existing classical "reality" cannot exist alongside the principle of local causes (the Einstein locality) and quantum theory, which is another convincing argument for abandoning the idea of a pre-existing reality in its classical sense. Such an idea is also most clearly pronounced in Bohr's (1958) so-called "Copenhagen interpretation" and the closely related interpretations of von Neumann, Heisenberg, Wigner, Wheeler and Penrose. Post-Wittgensteinian philosophers such as R. Rorty (1980) and the cyberneticians von Foerster (1984) and Bateson (1972) have had similar suggestions. J. A. Wheeler (1988, p. 4) also raises the question as to whether reality is a “great machine” in the sense suggested by Laplace or falls back on “an idea so obvious that it is not obvious?”. According to other interpretations (Cushing and McMullin, 1989) neither quantum physics nor Bell’s theorem make scientific realism impossible.

Nevertheless this debate must be considered very well founded since the primacy of subjectivity also call in question — if not to say to declare it nugatory — the object-oriented approach to science and the usefulness of the realist's postulate. These ideas have been around for about 50-100 years and since the scientific practitioner still, many times, carelessly applies the ideas of naïve realism (or some versions of a never satisfactorily defined critical or moderate realism) the situation seems rather alarming.

5. Perception is theory-laden.

Sciences are however thought to be derived in some rigorous way from the facts of experience obtained by observation and experiments. It also is widely held that science progresses through the intimate interplay of theory and observation. Since precise and clearly formulated theories are a prerequisite for precise observation statements it has been long since recognized that in that sense observations are theory laden — i.e., requires some background knowledge.

For our purposes the foremost issue is rather: Is perception theory neutral or theory laden, which is precisely to ask if the scientific theories we hold affect the character (content) of our perceptual experience? The findings of modern cognitive science are decisive on that point: Perception is highly theory laden. On the other hand there is no consensus about the degree of cognitive penetration, that is, in what way (and how deep) the human mind and performance is affected by the theories already adhered to. Churchland (1988) and Fodor (1984), for instance, agree that observation is theory laden, but the former argues that our scientific theory effects the perception itself, while Fodor suggests that only our description of the percepts will change with a change of theory. To the "outside" observer that can involve in communication only by means of description these disagreements make little or no difference — what matters is the consensus reached - observation is theory laden.

When we accept this state of affairs, we also accept that the theories we hold can change the data we get from our senses, and this seems troublesome for the objectivity of science. Even if there are

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\(^5\) or "quantum jump"
defenders of other views (P. Snowdon, 1990) such as how perception relates to a pre-given reality, let us for that sake scrutinize the modeling relation, which is elementary in the process of perception.

There are different definitions of the model relation. Most of them adhere to a description in which the thing of reality (the "original") is seen as the source of a mapping onto an abstract model of the thing under consideration (the "copy"). This definition and the terminology used clearly indicate that the realist's postulate is rashly put into use in this situation. The mapping procedure in use obeys the usual mathematical functional definition, where the "rules of modeling", that is, the rules of formalization are often regarded as self-evident.

This mapping procedure is not isomorphic. On the other hand, the “things of reality” or the like are the source of a homomorphic mapping (Casti 1988 and Rosen 1991) performed to produce the model — just the way a piece of landscape is portrayed by its map — with some bewildering details left out. This homomorphic mapping procedure (abstraction) can be illustrated as in fig. 4 by inserting a filter in the mapping path — thereby suggesting that the model is a “pale copy” of a richer original. This mapping actually specifies that all the elements of the copy — even if they are fewer — be directly derived from the original.

As a matter of fact such a “fade copy” in many respects can be more useful than the original since it just catches the relevant aspects of the phenomenon, which is in fact the characteristic feature utilized in the process of abstraction. This attitude of modeling we call descriptivism or representationalism and the tenets of dualism are very obvious here. In its most extreme case this is called naïve realism because it suggests that every element of the copy (the percept) has a counterpart in (relations to) an element belonging to the thing of the “outside” reality. In other words there are no elements found in the percept (the copy) that could not be derived from the outside reality (the original) according to this view.

In the modeling relation the reality phenomenon under consideration A (fig.4) is the original — and the percept the fade copy or model. That is to say, the model B is fully separated (or distinct) from the original A and this fundamental feature conveys the essence of abstraction — and also illustrates classical dualism. In this modeling relation (process) we recognize that A and B have a causal relationship (connection) so that some elements of A can be regarded as the cause of the corresponding elements of B. In the classical view the perceptual process defines a directed causal flow — reality is the cause of mind imprints. In human vision the causal connections are thought to be established by the sun's light rebounding from the atoms of the thing — then hitting the eye for further delivery up the visual perceptual path to human consciousness. This is how the realist envisions the things of reality and their "image-like" emergence in the mind of the observer.

6. The feedback of knowledge.

Let us for simplicity make use of a cognitive artifact — the one-channeled observer fig. 5 — an observer watching the presumed reality using just one sensor and sense organ. The idea that observation is theory laden, i.e., is affected by the observer's theory (thoughts) is introduced by the knowledge feedback loop marked F — an idea most prominently introduced by the early cyberneticians6. The question of cognitive penetration can now be reformulated into: To what extent is human perception affected by such cognitive feedback? We notice here that such “theory-ladenness” theoretically spans an interval from 0 - 100%. From a feedback neurally programmed to

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6 Norbert Wiener, Heinz von Foerster
disregard all data from “outside” (solipsism) to the level of no knowledge feedback at all i.e., all data coming from “outside” are accepted (naive realism). Such a view also allows for different shades in between according to the degree of cognitive feedback – critical realism. In this way the modern cognitive sciences explain the well-known multitude of illusions occurring during visual perception. (Bennet et.al. 1989) Solipsism means that the mind is a closed system (bare "mind spinning") whereas different idealisms, in spite of its often thought opposition to realism, are based on the idea that there is something humanity-common “outside” the mind that underpins the perceptual regularity and permanence recorded by human experience; God in the case of Berkeley and "eternal human ideas" in the case of Plato and Kant. Scientific realism, by now is very clear as a contrast, considers the “outside world” to be the root of our experienced perceptual permanency. From now on we will call such roots of permanency the "clues from outside" – a set of points called the "out-there-ness" that can be juxtaposed to the notion of classical reality. We shall thus accordingly try to avoid the notion of "reality".

My claim is that the primacy of perception and the considerations presented in the foregoing sections have shown that the classical idea of an observer-independent unary world is very difficult to defend any longer. Instead we must unhesitatingly admit that during observation we discuss and refer to the “images of mind” rather than to some “outside world” as suggested by classical science. This is an approach advocated in Husserl’s phenomenology (1960) - a branch of phenomenalism. However even this approach is not radical enough, because he “brackets” the question of the cause of the mind images. The subject-oriented approach claims the “objects” of perception must rather be epistemologically constructed outgoing from the privately experienced state changes in consciousness. Going down this avenue we will finally understand that the reality, or better the "out-there-ness", must be considered nothing more than a pure model theoretic conception — which cannot even be exposed to questions about truthfulness or falsity.

The introduction of the perceptual feedback loop fig. 5 also reveals that observation/perception is a decision procedure that takes place in the mind and not outside it, e.g. in the eye as normally suggested. This situation reinstates the importance of the Cartesian cut, but this time rather as a conceptual cut between a human mind and its environment. The debate touched upon here is about whether cognition — especially a scientific theory one believes in — can penetrate the observation and by how much. If so the theories we hold can change the data we get from our senses, and this situation is very troublesome for the objectivity of science as mentioned. The primacy of subjectivity paved the way for doubts and now both quantum physics and the cognitive sciences confirm the doubts we have regarding the realist's postulate and the usefulness of an "outside" reality conception in its classical sense.

To fortify the doubts in the next section we will involve in some model theoretic consideration that along the same lines will also indicate that science as practiced today — in spite of its proven success — appears to be both an inconsistent and incomplete endeavour.

7. Some model theoretical considerations.

Science is, to a great extent, most interested in knowledge for inter-private use, i.e., objective knowledge. Such knowledge, derived from facts and experience acquired during "objective" observation and experiments, is compiled into objective scientific models of the phenomena at issue. We say that personal opinions, preferences and imaginations have no place in scientific modeling — but scientific practice discloses quite a different picture however. The goal of modeling is to produce a description (model) that can be inter-privately used for retro- and prediction as well as interpersonal communication. In consequence such models must be observer-independent, that is, there must be no elements of the model that could be derived from the modeler himself/herself. Classically this criterion was thought fulfilling only when the observer was "outside" the system modeled, i.e., holds the position of scientific observer. However, in section 3, we concluded that unless we make use of the realist's postulate such a standpoint is impossible when observing the process of observation - doing 2nd order observation. In consequence a model also taking into account the process of observation must, by necessity, be constructed from "inside" and contain observer-dependent features, i.e., a model of the observer.
It is fairly easy to understand that the 1st order situation (as portrayed in fig. 1, sec. 3) is incomplete since here we cannot find crucial elements such as the eye, the perceptual path and the brain of the observer. Since such elements are unseen by any observer they cannot possibly be included in either a mathematical model or any other conceptual model - that then also renders any “insider’s” model incomplete. These crucial elements, are on the other hand, easily found in the classically recommended 2nd order "outside" view (fig. 3), which does not unfortunately contain the "entity under consideration".

We understand that such a limitation is imposed on any conceptual framework by virtue of the axiomatic method (Whitehead and Russel, 1925) used. Since any such framework is erected upon a set of primitives – and the “truth” of which cannot be proven within any abstract framework. For instance to make a mathematical theory “physical”, for that very reason, a set of statements called interpretations must be added, which establish the correspondence between the mathematical symbols and the physical concepts specifying the properties of the entities of reality. Briefly we could say that any conceptual (formal) framework is in principle ontologically disconnected from the idea of a pre-given reality.

Thus, in our role as observers, we are deeply caught in our role as "inside" observers and since our physical universe is a closed system (that is, we cannot step outside it) this situation brings forth the menacing consequence that science cannot produce a truthful and exact description of our physical universe. This claim is most prominently held by Roessler (1987) and the first alarming consequence is: Reality and the surrounding world cannot be objectively (in the sense of observer-independently) described by mankind.

Since we are as human beings doomed to be “inside” observers of our universe, let us see what the requirements are to study our physical universe or any other system as pure inside observers? To answer that question we must first understand that it is in the natural sciences where it is necessary to have an explicit observer-model included in (being inside) the formal scientific models used. To describe the closed system S (our physical universe for instance) in fig. 6 we need a model of "what is behind the eye", that is, our consciousness. This requirement unfortunately violates the realist's postulate. When our description of reality is dependent on a description of the observer (a model of its consciousness — the shaded area) then the reality description is clearly dependent on a model of the observer and the realist’s postulate does not apply.

So what? Let us then include an explicit observer model. The complication is, however, that we cannot possibly produce an explicit observer model of our own consciousness since we cannot be outside our own consciousness. This is so, out of necessity — since the considerations above have shown that one has to be outside the brain to produce an explicit complete and consistent description of one’s brain and such a situation is of course impossible.

Well, and then let us include an explicit model of some other’s consciousness instead! Unfortunately the primacy of subjectivity as stated in sec. 3 prevents us from such an undertaking. Once more: WE ARE CAUGHT IN A FATAL TRAP — a trap that makes an “objective” science impossible (or at least a science applied from outside.) The scientific observer cannot logically describe the world in terms of classical science – and such a conclusion is obviously devastating for the trustworthiness of science.

In conclusion: We are truly caught in our inborn capacity of being “inside” observers only, and thus we cannot completely and consistently model:

1. the physical world from outside, i.e., scientifically,
2. our own consciousness from outside — not even our sensory mechanisms

This is the essence of the fatal and irrevocable trap staged by realism and since the primacy of subjectivity also clearly shows it is impossible to produce a model of another’s consciousness — we

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7 This figure also hints us about the origin of a great variety of paradoxes - observing one's own eye is impossible.
cannot produce the required model of consciousness to complete an "insiders" model of the physical world. Even if we could, in spite of that, produce some model of consciousness, such a model would be heavily dependent on individual factors. To employ scientific models for scientific “objective” use, which are afflicted with personal traits, seems very ineffective and dubious and certainly contradicts the ideals of classical science.

In other words we cannot step out of our world to assume the role of super-observer and therefore we cannot build an “objective” science in its classical sense. Nor can we, when falsely pretending to be super-observers, understand our world. To establish a consensual science we are in need of models where models of human consciousness is left aside – i.e., is not a part of the total model.

There is also another predicament to be met since there are strong reasons to believe the laws of science that apply when one is in an inside part are different from the classical ones. In other words the rules of endophysics (inside physics) are different from those of exophysics (outside physics) — and certainly not interchangeable. Both quantum physics and the formalist/intuitionist struggle in mathematics during the 20th century bear such evidence.

So science as explained, in general, today is a very doubtful enterprise and to cover up for this embarrassing fact we evidently make frequent use of the realist's postulate – whether consciously or not. The crucial importance of this postulate stands out as being incontestably clear. Our, sometimes, uncritical devotion to “objectivity” has an obvious and doubtful reason and unfortunately such a devotion has also spread to the common human efforts to strengthen weak arguments.

Let us now summarize the facts presented thus far:

1. When tackling the process of observation we cannot use the object-oriented approach unless we at the same time adopt the realist's postulate. This is an inescapable consequence of the primacy of subjectivity.
2. Both quantum mechanics and modern cognitive science clearly indicate that the realist's postulate is unlikely and probably incompatible with their findings.
3. Finally the model theoretical considerations undertaken above will cause serious misgivings for the whole of science – and do so without any reference to quantum mechanics or the cognitive sciences.

So what we really have called into question is the imperative necessity of the realist's postulate. The surprising answer to this question is that this postulate is not only unfounded – it is also unnecessary. Even more surprisingly - we can rescue classical science by its removal. However the realistic postulate has underpinned the prevailing scientific ideal since the time of Galileo and such a claim is bound to meet severe counter-attacks. We should nevertheless expect a change of paradigm – a change that would for instance legitimise consciousness studies as a genuine science.

PART B:

8. Giving up the objectivist's position.

In the history of science there have been two approaches to the problem of building models of the world; the subjectivist’s and the objectivist’s one. These are referred to here as the subject-oriented approach and the object-oriented approach to knowledge. In the former, one takes the cognitive subject and its experiences as the point of departure, whereas in the second case one proceeds from a consideration of the "furniture of the world" — the things themselves — and a postulation of their existence clearly articulated or not.

Next we ask what are the consequences of the realist’s postulate. To answer this question the most obvious solution is to omit the realist's postulate completely and by reasoning follow the only avenue left — the subject-oriented approach to knowledge in an effort to regain confidence in our scientific reasoning. If this is possible we will have freed ourselves and science from the idea of a pre-given observer-independent reality – the tacit postulate of realism.

The discussions so far have revealed that the process of observation cannot be scientifically studied by the use of the classical object-oriented approach unless we apply the uncertain realist's postulate.
When we fully admitted the primacy of subjectivity we realized that the classical object-oriented approach must be abandoned in favor of the subject-oriented approach. On the other hand, scientific practice has proven that classical science nevertheless produces good results and accurate predictions, so for that reason one must suspect either its approximate validity or the effectiveness of some other features of human learning capacity to account for this situation. We will see the living brain’s capacity to adjust and adapt to the environment (the knowledge feedback) is a crucial factor in that respect.

Surprisingly enough, the subject-oriented approach with its very private point of departure will pave the way for a genuine definition of an inter-private (objective) universe—a consensual universe of science. In spite of the previously demonstrated unfeasibility, we will discover that scientific models can be constructed which imply an explicit "internal" observer (Kjellman, in preparation) and this stage is achieved by adjusting the classical point of view regarding the relation between human consciousness and its outside reality. At a later stage, most unexpectedly, a tiny loophole shows up, that also allows us to establish an explicit model of human consciousness.

Therefore let us take the subject oriented path, and view this strictly from the 1st order observer's situation with its privately proven car-imprint and ask in what way such a percept could be considered privately proven. The answer is: The private and intuitive proof is its perceptual existence and its perceptual recurrence, i.e., its cognition and regular re-cognition. In this way a living consciousness discovers there are similarities between many of its perceptual imprints, and attributes to each subclass of "similar" perceptual imprint a class name—thereby defining a subjective entity—and in this case the entity in question is called a "car". Contemplating this 1st order perceptual imprint in sec. 3 (the only source of information in the subject-oriented approach) some demanding epistemological and ontological questions emerge but here is not the place to dig deeper into these questions. Rather, to point out in which way the conclusions reached by the subject-oriented approach differ from those of the classical object-oriented approach and in which way they can help us shed some light on the problems met with in part A for instance.

9. The mind's outward projection.

The first problem to face is that not even the subject-oriented approach allows us to draw any far-reaching conclusions about any eventual "outside" object or world. For that reason we will avoid the possibly misleading conception of an "outside entity" (or thing) in favor of the more appropriate denomination the "clues from outside". This also mirrors the fact that the percept arising in the mind at a particular moment might also be a simple hallucination.

In the classical view, physics has developed a model explaining how data from outside (coming from the things of reality) are reflected and transmitted by means of light waves hitting our eyes on their way to our mind where they sort of "light up an image" which portrays the thing at issue. In this classical naïve view previously touched upon, the things of reality are involved in a mapping procedure, the images of which arise on the retina (or in the mind). This view has hitherto unmistakably and convincingly suggested that a unary singular reality surrounds the human brain. This is the classical view but still, physics has not taken the trouble to explain why this is so, while simultaneously asserting that these "images" are generated (by consciousness) "inside the brain"—at least when it comes to its secondary properties. Berkeley (1710) also raised the question as to how it is possible to compare an "outside reality" with an "image in the mind".

The problem is that the process of generation, i.e., the image generation process in the brain is physically totally separated from its object i.e., the image appearance in the "out-there-ness". An outward projection mechanism is assumed to be at work as is most prominently suggested by Max Velmans (1999). This outward projection mechanism is central to the subject-oriented approach and will, in fact, come to the rescue of scientific consensus. Once such recognition is reached one is also bound to identify this mechanism with the previously quoted "idea so obvious that it is not obvious" sought for by Wheeler (1988). The outward projections performed by the brain are the reason for the "out-there-ness" to sensually appear outside the brain—"located at the place" of the observed phenomenon—in spite of the fact it is internally compiled and generated by (and in) human consciousness.
This view gives rise to a different model of perception suggesting that there are some "clues from outside" involved in the generation of some mind-internal entities (constructed entities) that are outwardly projected onto the "clues from outside". In this view we could say that our mind practically "dresses the clues from outside" into the colourful apparition of the outside everyday reality we are so familiar with. In this model of perception (fig. 7) we are conceptually dealing with three phenomena: the "clues from outside" X, the abstract perceptual entity Y (a subjective mind construct) and the apparent outside "entity" Z (the outside thing), — the latter is the illusive appearance of the perceptual entity Y raised in the mind. As a suggestion the "clues from outside" mingle with the expectations (the theories embraced) into a perceptual entity, which is reflected back onto the "clues from outside". We could thus visualize perception taking place in two distinct steps: first a constructional step $X \rightarrow Y$, followed by an outward projection $Y \rightarrow Z$. However when doing so we once more fall back into the object-oriented way of thinking. In this situation we must remember that the only phenomenon accessible to our perceptual knowledge in the subject-oriented approach is the entity Y - and nothing else. To remain consistent, we must consider the perceptual construction generated inside the mind, i.e., Y to be the source and original, which is subsequently mapped onto the virtual "outthere-ness" Z. As a matter of fact a whole epistemology has been erected on this basis — called phenomenalism and according to this view the mind-entity (and its percept) is primary and the only source of knowledge. In this view human consciousness itself constructs (or creates) the features of the objects of perception – a view called constructivism.

Admitting this view we must adjust the interpretations of the concepts of science accordingly:

1.) The "outside" entity, that is, the colourful apparition of an "outside" everyday thing is the result of an outwardly projected subjective perceptual entity. This is the reason why the subjective entity appears "outside" consciousness.

2.) The implication of the projection "mechanism" is to encode the distance from the subject (consciousness) to the "clues from outside". This is a feasible and implicit way to perceptually include information about the estimated private distance to the "clues from outside" at issue. Clearly the ability to estimate the distance to a passing tiger is beneficial to most living beings and was not its "image" outwardly projected such information would be missing. Apparently we are so addicted to this projection "mechanism" that it is very hard even to grasp. Clearly as infants we use the sense of touch and the motion of the hand to set up the basis for this useful phenomenon. What is added to the percept besides the apparition of the perceptual imprint is thus left for the other senses to settle, for instance to characterize the phenomena of extension and mass amongst others.

3.) The perceptual imprints that have arisen in our minds are affected by our expectations and the theories we embrace as pointed out in section 5. In spite of other suggestions we thus "see" mainly through the mind and not only the eye. Perception takes place in consciousness and not in the senses – mental operations that finally result in a useful "out-there-ness" by the outward projection of the privately constructed entities. Which imprints are, or are not, perceptual are also decisions made on a strictly private basis. In this view perception is clearly a process of inference, but the causal flow of intellectual construction is reversed. The outside entity is inferred on the basis of the percept, which has arisen - and not the opposite. Outside entities are then also the result of deductive inferences on the perceptual level. These principles have been discussed before in the literature on perception (Bennet et.al. 1989) but then always as seen from the object-oriented perspective. In the subject-oriented view there are no real or permanent entities, rather all outside entities are hypothetical and must accordingly be called model entities in order to underline that they are fictions and subject to modifications in the light of theory improvements. Consequently we use
these outside entities and the "out-there-ness" as a pure instrument to direct our actions and support eventual inter-subjective human communication. In this respect the "out-there-ness" has very little to do with Popper's idea (Eccles and Popper 1966) about solid bodies as the paradigm of reality.

4.) The "out-there-ness" (my reality) is a strictly private understanding about some "universe" and the result of perceptual construction. The set of percepts (originals) experienced by any consciousness is in this view a private collection — a priverse (a private universe) — and makes the classical reality as perceived by any individual consciousness a true private construction. Not entirely free of course since it is thought erected from outside cues. In conclusion, then, there are as many realities as there are living beings in the world. Human knowledge becomes a private understanding about a "universe" of consciousness experience — constructed, organized and assisted by the one and only centre of perception and inner experience — the human mind.

5.) In this view the percept (or subjective mind entity) is the epistemological origin. Since the "clues from outside" are mingled with our unseen expectations, the percepts that have arisen are their primary occurrences. All we can say in this view is that the percept is the mind's hypothetical suggestions of some "outside" entities. This is neither a process of reconstruction (since there is nothing to re-construct) — nor is it a re-presentation (since the mind entity at issue is the original (the primary presentation)). The perceptual original originates in the mind — this is the essence of the enforced primacy of subjectivity and whatever else there is "behind" its appearance is the mind's pure speculations. On the other hand the experience we have gained that the observations performed on certain specified "outside locations" always give rise to "similar" percepts is in the subject-oriented approach a clear indication of the existence of an outside quasi-stable structure — the "out-there-ness"

So following on from acknowledged state transitions in conscious experience our intellect constructs an outward path to a hypothetical cause in the "out-there-ness". In that respect we could say that the causal flow (of intellectual construction) is reversed compared to the classical and suggest an answer to a question H. Stapp (1998) has posed in a recent paper:

"This question of which way the causal influences runs is probably the most basic question in both science and philosophy: Are the physical aspects of nature in complete charge, as they are in the classical picture of nature, or do the experiential aspects of nature have a degree of autonomy that can feed into, and effect in a significant ways, the flow of physical events?"

In the subject-oriented view the percept is the precursor of the "outside appearance". The fancied entity in the "out-there-ness" (the classical thing of reality classically speaking) is a private image seen in the form of the outwardly projected percept. The percept is the suggestion of what form and other properties our mind finds suitably to attribute to the "clues from outside" at issue. As a matter of fact an observing mind always calls into question whether the arisen percept should be attributed to an "outside" entity or dismissed as a simple illusion.

Notice that the subjective entity is produced in the mind only. The mind learns to construct a suggestion "how to dress the clues from outside by appearance data". These suggestions are adaptively adjusted in a circular process to the point where the “dressed clues” (the subjective entities) produce successful predictions. These suggestions are very useful since the mind uses these interpretations (theories) on all later occasions. So in the build-up of a theory this learning process is clearly circular suggesting the necessity of considering an undivided wholeness as proposed by David Bohm (1980). Maturana and Varela (1973), and von Foester (1974) have also put forward similar ideas.

Every time a mind happens to doubt its interpretation of the arisen percept (or for some other reason need a confirmation) the circular projective-perceptual path must be fully re-established. Evidently this approach also makes Cartesian dualism superfluous. This constructive loop is made up of events and data (information) in the sense proposed by Whitehead (1979) and Wheeler (1990) — but the origins are not worldly events rather mental. The perceptual imprints are the prime phenomena of science that arise in consciousness on a very subjective basis — as subjective entities. These
events emerge in human consciousness on a private basis but then become the seeds of some hypothetical outside events that make up the "objective" basis to explain the subjective entities appearing in my experience. These private and subjective entities are the basis on which we in section 11 can re-construct classical science and put it on a sound base of scientific consensus.

10. To which entity do we attribute properties?

Now the interesting question arises as to whether we shall attribute the subjective forms and properties to the "clues from outside" X, to the perceptual entity, which has arisen in our mind Y, or the resulting outside entity in the "out-there-ness" Z? This question leads us directly to the heart of the dispute of a quantum reality. Here we can just hint at the answer: Forms and properties can only be assigned to the "inside" phenomenal entities. This claim captures the essence of Bohr's, Wheeler's and Heisenberg's interpretations of quantum physics, i.e., that we cannot speak about a state or property until the observation (measurement) in question is actually performed – i.e., is part of our knowledge. Once von Neumann extended these interpretations by suggesting that a measurement process (observation) only occurs in the mind, thus giving consciousness an independent role in this process of construction. This is also in perfect agreement with the suggested interpretation – and the need for the famous collapse of the wave function vanishes – or at least reduces to a plain metaphor.

In the classical view the forms and primary properties belong to the "things of reality" X or Z - in most interpretations, but Bell's theorem says that this is incompatible with the findings of quantum physics. The subject-oriented approach advocated in this paper has also proven such incompatibility on other grounds. We must conclude that the "clues from outside" are virtually unseen (cannot be assigned features) by any consciousness and therefore lack substantial properties. For that reason they can rightfully be assigned neither forms nor properties. The mental imprints and the constructed mind-entities, on the other hand, can be attributed such features.

We must never forget that in the subject-oriented interpretation Z is nothing more than an outward projection (illusion), the apparition of which classical science has misleadingly taken for the real and permanent entity (the thing) of a fancied unary reality. In the phenomenalistic view the "out-there-ness" loses its former exceptional ontological status - becoming a bare phenomenon of cognitive stability comprising the "clues from outside"— which, in close relation to the scientific theories we embrace, gives rise to the vivid and colourful percepts we call mind images - that we internally compile into our respective priverses. The ontological “what is”-question is now superseded by the epistemological question “how do we construct”. Ontology gives way and all there is - is epistemology.

11. What happens to the objectivity of science?

The choice of the subject-oriented approach to knowledge in the study of the process of observation was not made because of some appealing features or the like. This path was chosen because our aim at consistency and completeness in part A clearly showed this approach to be the only remaining alternative. In spite of the universally repudiated reputation of subjectivity we were forced to take this path. This approach resulted in a scientific multi-reality situation and through recognition of the outward projection mechanism we can now literally say that we as humans all carry our own private reality - the priverse - inside our mind.

Surprisingly enough it is through this situation that it is now possible for the individual to produce a model of his/her priverse using a description that does not contain any elements related to his/her own consciousness. When describing my priverse accordingly it becomes the legal subject of a consistent and complete description — in spite of the limitations accounted for in section 6.

Just in the same way it is possible to internalize a cellular automaton in an ordinary computer we realize that the priverse now has to be successfully internalized in human consciousness by taking on the compelling subject-oriented view. This priverse automaton works like an "internal priverse presented before the mind" as explained in the previous section. For that very reason my priverse

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8 it is very feasible to envision the private reality as occurring on a mind-internal TV screen - behind the senses and disconnected from the "out-there-ness" so to speak. It is a peculiar feeling the first time one catches a glimpse of this situation – all of a sudden one feels a personal responsibility for its appearance
obey the rules (most of them) as developed in classical physics and this is probably also the reason it took until the 20th century for mankind to discover quantum phenomena. On these grounds classical physics is valid and is still very useful in the world of everyday macroscopic phenomena.

When a priverse (including its laws) is carefully developed such a model will, on a private level, be very useful for making predictions and calculating the outward actions to take — a sort of private science. **We discover a vital function of a living consciousness. The imprints (subjective entities) produced become a tool of (models for) "visualization" and very helpful in predictions and directing the outward actions of the individual organism.** In this situation we readily see that the "out-there-ness" can be treated as a plain “black box”, which is fed by the outward actions of the individual and which responds to changes that are in turn perceptually recorded (measured). Supported by the mind the percept that has arisen almost has the role of an individual’s "instrument panel" to carry through9 these tasks. The permanence of the "out-there-ness" is the obvious guarantee of quasi-stability in this control task. The question as to how my percepts relate to someone else’s is irrelevant in this situation — as are the questions as to whether we envision this "black box" to (re)present reality, God, some eternal platonic ideas or anything else. All that matters is that the "black box" is a quasi-permanent structure, which explains why the "same" subjective entities emerge in my percepts when prepared observations are repeated under the "same" specified conditions.

**What is of utmost importance though is that now every subjective entity constructed in this way has no explicit reference to human consciousness, i.e., they come very close to the previously mentioned scientific ideal of scientific communication.** Of course there is still an implicit reference to the individual consciousness since these entities all are private — but we will see there is a cure for that.

For that reason the next step here is to produce (construct) something that in contrast to the private imprint with its contained subjective entities can be the object of inter-private (scientific) examination and communication — **some inter-subjective (or objective) entities.**

Since the word “objective” has achieved10 a cultural and scientific loading, which is somewhat diffuse and misleading, we will instead use the term **consensual.** So we will speak about the personal, private or subjective entities emerging “in” our percepts on an individual basis - as opposed to the consensual, inter-private entities that are the intellectual constructions used when defining the shared objects of science. This is something considerably different from Popper's “paradigm of a materialistic reality.”

12. **The consensual universe is an agreement on a consensual and common model universe.**

All priverses, according to the proposed view, are now private and come in different varieties, but now by being “inside” they are consistently and completely describable by the related consciousness. In other words, a consciousness can produce an **explicit model of its own priverse** (or a singular subjective entity being part of its priverse) **without self-reference.** These model entities can be displayed (laid out) outside consciousness in the form of **external11 (physical) models** (fig.8). Such external models (constructs) are the only ones accessible to other people.

In this way every mind can produce external models of the subjective entities embraced by it and such descriptions do not contain any elements that can be derived from itself. This is an important

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9 compare this to the situation when a pilot lands an airplane in darkness. By the use of instruments he safely brings down the plane without the slightest glance of “reality”

10 I claim this is mainly due to the futile efforts trying to save scientific objectivity through the use of words

11 such external or physical models are of course nothing else but some clues laid out in the “outside” that in turn produce mind impressions also in other human minds
achievement since we have now attained our goal – an observer-independent description of a priverse and its conceived entities. The external observer-independent models as described above are the communicable and suitable objects of an inter-private comparison process. Should it be that such comparisons repeatedly show that models of the subjective entities always turns out to be different, i.e., strictly private, then we have to let go of the idea of achieving a scientific consensus. In that situation every individual must develop a private science of his or her own and such a situation also the natural language reduces into a strict private language.

Scientific practice fortunately indicates that this is not the case, rather that the classical idea of scientific objectivity (even if in principle misunderstood) has proved to be very suitable. This indicates that there are brain-internal adjustment mechanisms at work (fig. 8) that allow for the tuning of the human perceptual/action capacity to effectively arrive at a state of consensual inter-private understanding. This is achieved by privately building up our theories and modeling ability and at the same time, in a learning process, adjusting the perceptual neural network in close social communication and coexistence. There are reasons to believe that the lengthy processes of upbringing and education coordinated with communication and close coexistence (Piaget, 1938) induce the neural networks of human beings to internally adjust the perceptual apparatus until the models of our subjective entities watching the same "clues from outside" appear to be “similar”.

As a proposal we call the entities which are the result of such a lengthy process of adjustment - a consensual entity (a model entity) - and the totality (the set) of these entities - the consensual universe of science (a collection of models). Such a consensual entity conception bears the flavour of a collective “mean value” rather than something that can be related to some ontological or eternal truth in classical sense.

So when it is possible to reach consensus regarding the definition of a model entity when watching the same "clues from outside" we are prepared to define a consensual entity of science, which of course is nothing else but a model – a c-model. The description of such a c-model is in a formal sense independent of the (individual) observer and independent of the group that was involved in the process of consensual understanding (fig. 8). This is a great achievement since we now have at hand a set of observer-independent models to define our abstract consensual scientific universe. Still these c-models implicitly programmed by individual neural networks have a very private touch – private to the individual or the group. However in the formal description of the c-models there are no reference to any individual consciousness – and therefore we can all use these c-models in virtue of the discovery of the internal mind adjustment process.

13. Replacing the lost classical reality with consensuality.

When it is possible to come to an agreement on a suitable model when watching the "same clues from outside" such a model portrays a consensual entity (which is juxtaposed to the classical “objective” thing of reality). And we must proceed until consensus in this sense is achieved by mutually “tuning our minds”. Science uses such a process of entity constructions for the definition of a set of models called the “consensual reality” or consensuality, and it is very important to notice that these mentioned c-models are in principle entirely different from the singular real (or material) things defined in its classical sense.

Figure 8 also gives a broad hint that the way to such consensual understanding for the individual is to adjust the language, modeling techniques, personal theories and perceptual mechanisms used and thereby attain an inter-private agreement about the consensual entities and our common scientific model-universe. Such a process of upbringing and education that starts very early in life is of utmost importance for the individual in order to arrive at a level of consensual scientific understanding — and a common language of science.

Related to every subjective entity there is also a certain (subjectively experienced) behaviour — the laws followed by the entity at issue — some of which we traditionally have compiled into the laws of nature. Since both nature and reality vanish in the subject-oriented approach we now understand such laws most of all are the laws of the mind. In this view we also understand that whether the model of the consensual entities displays a particle-like, wave-like behaviour or both is irrelevant as

12 So a bat would not agree! And a social scientist could very well disagree on a physicist’s interpretation — as a matter of fact a lot of scientists still disagree about the quantum interpretation.
long as the model in use allows for good predictions. What is “behind” the experienced mind-model phenomenon is in principle hidden to all human knowledge. In that respect the provoking particle/wave dualism, as exposed by quantum mechanics, is the sole result of deep human confusion about how to apply the findings of human experience and its relation to some presumed “external” reality. Whether the “clues from outside” exist or not is plainly a matter of definition – redundant however. The inferred knowledge of such “clues” can exist in a living mind only in the form of knowledge. They can exist only as intelligent guesses – since the messages from clues are dressed by mind beyond direct recognition. The abstract model-universe of science is accordingly a consensual suggestion of a collection of model entities (and their related behavior) — virtually unseen\(^\text{13}\) by any human or living mind — which in the subject-oriented approach is brought out in a process of inter-private scientific agreements.


Now it is possible to envision Science (or any branch thereof) as a fictitious "collective mind" (CM) in which a special model universe is embedded — a consensual universe of discourse or the common consensuality of mankind. What is fed back by the fictitious feedback loop of the CM are the theories of science and the internal models of this CM have very appealing features since they all lack explicit reference to both CM and any other mind. This is a property we really demand from a consensual model to be used in science. Of course, they have an implicit reference to the CM — but this is the point! They reflect the group consensus - they are the recognized and common models of science and as such collectively certified.

Education and communication are the available means to train an individual mind (scientist) to come close to the consensual ideal of the CM, and as already pointed out, the only way to arrive at a useful framework of consensual scientific understanding. Kuhn (1962) is fully agreed on that issue, but this paper shows that this state of the art cannot be attained unless we leave the objectivist's position of classical science. In doing so the classical conception of a unary observer-independent reality breaks down inasmuch as reality must be seen as a strictly private construction – a priverse. In this view we all carry our own reality inside ourselves in the form of our knowledge and collected conscious experience. That is to say my priverse is formed by the set of events that has occurred to me (including their conceptual organization) — which is surely something different from that which has happened to any other living being. On the other hand CM is a common and consensual construction embracing what has happened to all mankind thereby forming its collected wisdom.

Many people insist there must be something entirely wrong in proposing a change of paradigm when taking into account the outstanding success of the modern sciences. To claim an “outstanding success” is also a very relative statement. We are able to land human beings on the moon but on the other hand we can do nothing to prevent wars and the devastating conflicts among ethnic groups – some people would definitely not call this an outstanding success. The point however is that even the successes of modern science are probably not due to its theoretical foundations – that has been shown to be rather confused - but rather to the successful methodology of experimentation.

From time to time, the “underlying principles” of science have changed substantially, and yet the building has never collapsed. The switch to classical mechanics during the time of Galileo and Newton time replaced some “fundamental” assumptions of physics yet the inheritance of antiquity remained essentially intact. The downfall of Euclid’s classical geometry did not mean that we had to rebuild mathematics from scratch. From classical to relativistic physics, and later to quantum mechanics provided an even greater change in basic assumptions, but this, too, was dealt with. The vast body of knowledge built up so far in chemistry has remained valid: verified phenomena remained verified, and so have their empirical relationships.

What type of construction is it, this grand structure of science that remains intact even if you change the basic assumptions? The conclusion we draw from this picture is that the methodology in use has produced good results in spite of slight human misunderstandings. The real support for any scientific theory ultimately comes from experience: from experimentation in the lab and from observations of phenomena in the presumed nature (our model universe) and its validity has been reinforced by learning, close cooperation and consensual understanding.

\(^{13}\) I believe this is the essence of the term "das Ding an Sich" as used by Kant
What science describes and predicts are the happenings around (or inside) someone and it is always a human agent, busy observing, acting and constructing that describes these happenings. As we climbed through the levels of complexity, we soon reached the point where we started to observe ourselves and the process of observation – at first as outside observers in the spirit of Galileo. The cyberneticians pointed out that we were caught in an endless loop and we are now forced to redefine the whole of science from the position of an inside observer. This will certainly change the theoretical framework, descriptions and explanations. This will not change the happenings though, since we have always been inside observers – sometimes unwittingly – in spite of our efforts to claim objectivity of observation. The laws of nature do not change because we compile them into the laws of the mind – but we have begun to understand that the human mind affects the happenings of life much more than do the clues from outside. Here we encounter the human agent that sets up the experiments and defines the relationships between the observer and the observed happening. The description of the happening will change slightly, the explanation considerably – but the happening will remain essentially unaltered. The experimental methodology that was so very helpful in developing classical science remains intact and is still in full force - the useful method sieving out loose (and therefore subjective) speculations from the discourse of science still remains the consensual ideal.

The subject-oriented approach is something entirely different – it takes the stance of the inside subject in the discourse of science instead of conjuring it away in an attempt to produce an object-oriented situation in the spirit of Galileo. The detached observer was very useful for physics – however, paralysing for the humanities. Physics has now reached the end of the road – a radical reorientation is required. The humanities will follow in its footsteps – or shall we say pave the way and discover that human feelings will be the legal subject of science and a fundamental concept in a science to come.

15. Conclusions.

Quantum mechanics and the modern findings of the cognitive sciences have made us doubt scientific realism and the usefulness of the realist's postulate. Instead following the compelling path of constructivism, which brings about numerous internal private realities, we can come to the rescue of science by rejecting the idea of an observer-independent reality in favor of consensuality – a set of models based on a scientific consensual agreement.

The price to pay is to let go of the classical idea of a real-world truth based on correspondence in favour of the pragmatic truth criterion based on usefulness - as first formulated by Pierce. The bewildering Cartesian dualism vanishes in favour of a mental monism – reducing the real world to a construct - classified physical because it is understandable through means of the senses.

A similar approach can also be used to obtain an explicit model of consciousness, which in this view becomes the legal and consistent subject of science. We find a huge and important role of human consciousness in its function of dressing the clues from outside into a compressed and vivid model ready made for fast action, i.e., action without preceding explicit computation.

The subject-oriented approach finally dispatches science into an instrumentalist's endeavour, that is, the conception of the "out-there-ness" in principle has nothing to do with any "physical appearance" or the like, in the everyday sense of the word — it is rather solely an instrument (a model) for everyday and scientific predictions. The state of successfully reached scientific consensus, as proven by scientific practice, is attained by upbringing, education and devoted scientific inter-subjective communication to allow for:

- Successful future predictions (its usefulness on a private basis)
- Effective social communication and cooperation (its usefulness on an inter-private basis)

To carry through these tasks evolution has furnished the living mind with a phenomenal centre called consciousness displaying a colourful and vivid apparition just in order to aid the organism in its actions and allow for an apparently "visual survey" of the imminent situation. This becomes the

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14 Peirce, J. S., (1839-1914) called the father of pragmatism
15 Kjellman, A., The Subject-Oriented Approach to Science – in progress.
effective private instrument for both prediction and inter-subjective communication when properly tuned to the available scientific practice in use.

Since we are brought up by a common society and in very close communication with other living beings, we have learnt to internally adjust our private experience, thereby staying in effective communication with our fellow beings. We do so by adjusting our priverses, through the build-up of theories and adjustments of our perceptual apparatus and modeling ability in an ongoing close social communication and coexistence.

Suggesting such a radical reorientation one might ask what happens to science. The concept of truth will radically change for the better and alongside it the rules of logic. The curse of Cartesian dualism is forever dispatched. In the proposed mental monistic approach there is neither matter nor mind — and in this setting it is pointless to assign absolute states to the “objects of the world”. Many terms lose their “inborn taste of objectivity”; they all reduce into collective common agreements where the natural and social sciences confl ate. Measurements, perceptual impressions and inner feelings become nothing more than subjective facts to be treated at the same level of experience — it is just the choice of concepts, tools and measuring sticks that makes the difference.

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SOCIOCYBERNETICS - THE PATH TO A SCIENCE OF BECOMING.

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Abstract:
The problem of consciousness cannot simply be approached from a third person’s perspective – the classical approach is bound to fail. A science that cannot account for human feelings will leave out the most important factor affecting human decisions.

Cross-disciplinary approaches can provide a better understanding and sociocybernetics is the name of the combined efforts of cybernetics and the social sciences - that will provide a basis for the understanding of both the nature of the mind and of human communication.

Cybernetics has already foreshadowed a radical reorientation of human thinking through the feedback mechanism – suggesting a constructivist epistemology to expand the ideas of the prevailing, if somewhat misguided realistic ontology (materialism). They found that the observer must be included in the description of the system observed which was also the confirmation of the new ideas of quantum physics. This finding violated the basic principle of scientific discourse - the separation of the observer from the observed – and resulted in accusations of non-science.

To see the predicament of modern science, which had replaced medieval speculations. We must put the clock back to the time of Descartes, Galileo and Newton. In an attempt to liberate science from magic and pure personal speculations they proposed that science should cease speculation and instead concentrate on description. Empirical observation and mathematics were the correct methodologies to use in science. This has since become the ideal of the scientific observer – the third person (external) observer – who could reflect on the “common reality” from outside and provide truthful models useful to the rest of mankind.

This move has led science astray and banned consciousness studies from science. The subject-oriented approach, on the other hand, avoids reality postulation – and finally arrives at a new definition regarding objectivity (and consciousness) that also demands revision of the realistic conceptual framework used in the natural sciences. This is in agreement with second order cybernetics, which claimed that the goal of science is to explain the observer to himself/herself – and thus explain science to the scientists.

To that end we can rely on the works of Descartes, Berkeley and Hume that lead the way for phenomenology. The path we must enter upon is to admit the primacy of subjectivity and from this bright intuition find out that living beings construct their private universes – priverses – inside themselves. In this way we can restore the forlorn scientific objectivity – not in the form of some observer-independent description but rather in the form of a model universe based on a firmly established scientific consensus. In a way sociocybernetics and the subject-oriented approach can pave the way for the understanding of consciousness and human society – laying out a reasonable consensual framework for a cross-disciplinary approach to use in all sciences.

1. Introduction.
Sociocybernetics – a strange word indeed – and probably totally incomprehensible to the uninitiated. Therefore we must first find out the reason for the concatenation of the terms “social” and “cybernetics” into the term “sociocybernetics” – find the motivation behind its use and at the same time try to characterize the principal traits of such a discipline. In doing so one readily discovers that even the separate terms “social” and “cybernetics” are not too well-defined and are also in the need of an explication – otherwise the term sociocybernetics runs the risk of being regarded primarily as a funny catchword. However we will see this is not the case at all. My claim is rather the opposite – namely that the discipline of sociocybernetics has, albeit accidentally, become a productive melting pot for ideas that will open out into a science of becoming, i.e., the science of the future. In this role it will extend and replace the prevailing classical Newtonian paradigm that has hitherto effectively permeated the sociocultural domain. Such a science, of course, will embrace the frameworks of

1 http://www.unizar.es/sociocybernetics
quantum mechanics and consciousness studies and will, coincidentally, vitalize life and social sciences - the latter two will, in this case, be placed side by side with the natural sciences and mathematics.

Fortunately the change we are facing is an extension of the classical paradigm but nevertheless a simultaneous radical reorientation of our scientific thinking is being asked for. The reason is that the classical object-oriented approach to knowledge must be replaced by an epistemology taking the stance of the observing subject and its knowledge - the subject-oriented approach to knowledge. In this view one takes the cognitive subject and their private experience (the phenomena of mind) as the point of departure. Surprisingly enough such a seemingly counterintuitive approach ends up in a consensual science that can claim both consistency and completeness – a state unattainable by the sole use of the classical object-oriented approach (Kjellman 2000).

The subject-oriented viewpoint is very natural for most living beings, especially the immature child, since it is the view of everyday life. Inspired by physics the Western ideal of scientific thinking, however, has been the thinking of the “detached observer” and for that reason science must now regain the ability to also apply the first person perspective correctly. The price that must be paid is that we must develop a new language for use in science, since the classical assumptions about the nature of knowledge, time, being, truth, state and so on, evidently permeate all natural languages. This is presumably because we evolved as observers watching our environment, which we naively have regarded to be a unary reality. Used as a fundamental postulate erecting a science of mankind, however, this idea has become the paralyzing step, which for a long time has banned psychology, consciousness studies and the social disciplines from the arena of science and almost irrevocably separated the natural and social sciences into two rival domains.

Cybernetics, on the other hand, is a cross disciplinary science, and since sociocybernetics is the discipline where social and natural science intermingle it should come as no surprise as to why the infirmity of classical science is experienced as a severe obstruction at an early stage. The science of “living subjects” and their societies has since long been the object of discourse belonging to psychology and sociology and for that reason the subject oriented approach to knowledge appears here as a compelling necessity. In this situation, however, we are more precisely talking about science as the bulk of “knowledge embraced by living subjects” – a science many people would rather juxtapose to systems sciences. Such an attribution is not correct however since these classically have also taken on strict object-oriented approaches and for this reason stayed loyal to the classical paradigm. Human feelings as a determining factor of human action have never been legitimised apart from in the social sciences and culture. This is why we need to put the prefix “socio” before “cybernetics” and the acceptance of human feelings as a common ground for decisions and communication in a science of becoming.

The paper is organized as follows. In section 2, the essential features of “sociocybernetics” that almost accidentally made it a pointer to a science of becoming are explained. Section 3 and 4 deals with the shortcoming of classical science and how the avoidance human feeling, especially in the natural scientific discourse, has gradually become a severe obstacle – especially because of recognition of the feedback features built in the human brain. In section 5 we look back in an attempt to understand the motivation for the scientific revolution and the rise of new rules especially for the natural sciences – and how they come to be the norm setters of science in general. We point out that the search for truth and certainty, an unfounded postulate, was introduced and has more or less come to the rescue of scientific realism. Section 6 claims that not even the great natural scientists were “objective” – and this was to the benefit of science and section 7 take a closer look at Descartes’ subjectivity, which embraced the subject-oriented approach to knowledge. We also find the reason why he was accused of turning his back on human feelings and look at the rise of Cartesian dualism. Section 8 concentrates on his quest for certainty to elevate human intuition and feeling as the resource behind human reason. In section 9 we outline how to correct Descartes’ approach by combining it with Berkeley’s to build a science of consciousness – and a science of sciences – a constructivist epistemology as espoused by the cyberneticians incorporating some modern findings of the cognitive sciences. Here human intuition and feelings will have a central role and section 10 maintains that even classical science was subjective in spite of its “objectivity” reputation. In section 11 and 12 the targets for new science of becoming take form. Using Descartes’ method of doubt as a starting point, we can

2 taking the objects (or the things) of the world for granted without any definition
develop working instrumentalism based on Brouwer’s intuitionism and cybernetic constructivism to explain both human consciousness and its relation to an opposing private reality – the priverse. However the classical framework must be extended and in this new endeavour we must place our trust in human feeling and intuition. Section 13 contains the conclusions.

2. Cybernetics and sociology.

The first strand is: What is cybernetics? Norbert Wiener (1948) inspired by the success of control theory and operations research during the Second World War distinguished cybernetics as a new discipline. He called it the science of control and communication in the animal and the machine. The field involved interest in the concepts of information, feedback, and control - generalized from specific applications in engineering to systems in general, including systems of living organisms, the nature of purposive, goal-seeking behaviour in natural and man-made complex systems. From the outset, key thinkers recognized that there is a fundamental unity of interest between cybernetics and general systems theory (GST) but that historically they had developed in different contexts. GST argues that however complex or diverse the world is that we experience, we will always find different types of organization in it, and such organization can be described by concepts and principles, which are independent of the specific domain we are looking at. Hence, if we uncovered these general laws, we would be able to analyze and solve problems in any domain, pertaining to any type of system.

GST has always remained true to the classical paradigm of science, cybernetics in contrast has elaborated a constructivist view where objectivity derives from shared agreement about meaning, and where meaning and information are attributes of an interaction very much the same as in the sociocultural domain of a society. H. Maturana recast the concepts of "language" and "living system" from the cybernetic viewpoint [Maturana & Varela 1988], by shifting their opinions away from the concurring AI perspective. "Learning is not a process of accumulation of representations of the environment; it is a continuous process of transformation of behaviour through continuous change in the capacity of the nervous system".

The field of AI came into being when the concept of universal computation [Minsky 1967], the cultural view of the brain as a computer, and the availability of digital computing machines were combined. Cybernetics started in advance of AI, but the latter has dominated the last 25 years. The current fashion in neural nets could be seen as a return to old-style cybernetics. However much of the modern work in neural nets rests in the philosophical tradition of AI and not that of cybernetics. Recent difficulties in AI and the findings of the cognitive sciences have led to a renewed search for solutions that mirror the past approaches of cybernetics. In this paper, I will argue that impetus from the cyberneticians resolved the consciousness puzzle [Chalmers 1995]. By assimilation of the sociocultural factors of intuition and feelings the natural sciences will be able to take part in defining a science of becoming – which will overcome some of today’s difficulties.

Next let us examine the other strand: What does "socio" stand for? It stands partly for sociology, i.e., the study of human social behavior, especially the study of the origins, organization, institutions, and development of human society. In that respect the analysis of social institutions or societal segments as self-contained entities or in relation to society as a whole displays itself. The term "self-contained entities" here unmasks the close connection to computer science and its interest in "interacting software agents" diverging also into the life sciences – especially biology. The origin of the physical, social, and cultural development and behaviour of man is of course implied in the term "socio" but, on the other hand, it also has strong connections to psychology and anthropology. Given this background we are tempted to claim that "socio" then implies the study of organizations both in the tangible and abstract. Taking this stance is not wise, however, since "sociocybernetics" then implies the same thing twice over – recalling that the study of organizations is the defined favourite subject of cybernetics – if not to say for GST.

We must therefore claim that the prefix "socio" is not present to enhance the organizational aspects of the discipline of sociocybernetics since this part is already taken care of by the term "cybernetics". Another interpretation could be that the Wienerian "animal and machine"-concept is thereby enlarged to also include whole societies, however, such a move seems far-fetched. We should rather concentrate on the control concept as defined by cybernetics, as a suggestion, and concentrate on the human/social (living) aspect of control – namely the feeling. This very powerful force of human living that overshadows most of our deeds and actions has been effectively rejected by many tenets of classical
science for several hundred years. The dictum has been: *There is no place for feelings in science!* This is a serious misconception however – a science with no place for feelings certainly has no place for life. No wonder science is unable to tackle the problems met with in the life sciences and consciousness studies. This is science at its worst – this is the plain technology for watchmakers.

In this interpretation "socio" stands for the most forceful and expressive factor of living behaviour – the *feeling* – also including bodily "inner" feelings. Therefore the research direction imported by sociocybernetics will help us re-open the door closed by Galileo and Descartes and then so carefully nailed down by Newton. At least we think they did, but science as practised since those days tell us quite another story. In spite of this saying and the indiscriminate homage to objectivity – we will see the door was not closed at all - fortunately.


The cracks in the armour of classical science started to appear in the 1920's when physicists researching quantum physics started to investigate the assumptions underlying human observation and later in the 1950’s when the science of cybernetics became interested in 2nd order observation. The Copenhagen interpretation [Bohr 1958] shook the foundations of physics and Bell’s theorem [Clauser and Shimany 1978] made it clear that the realistic approach was very uncertain. Even earlier the founder of intuitionism, Brouwer (1907), based on constructive mathematics, had started to question the rationality of human thought and thus foreshadowed Gödel’s two theorems 1931 [Gödel 1962] that effectively closed the door on Hilbert’s formalist program.

Another acute problem was that it seemed human knowledge and consciousness could not possibly be captured by classical science. Now at the turn of 21st century we begin to understand that the problem of consciousness cannot simply be approached from the third person’s perspective as so clearly advocated by classical science. Since the methodology of science is also developed using the same paradigm – the classical approach to the problem is very likely to fail and so are attempts of classical interpretations. After all, the entire standpoint taken by behaviourism and B.F. Skinner (1972) was very consistent with the ideas of classical science: “*mental processes may exist, but they are ruled out of scientific consideration by their nature.*” So deep was the faith in a pure realistic science in those days that scientists were very prone to leave the phenomenon of consciousness fully outside of scientific endeavour and did so for more than six decades.

This state of affairs cannot last long since *science is most of all the art of predicting what is to come in future and on the grounds of these predictions undertake clever actions to secure the survival of the individual and/or the society.* This is generally done by either influencing the evolution of the environment or simply by avoiding confronting upcoming danger. Concerning the possible actions to take in a particular situation both individuals and society have many options to choose from – and here sound decision-making is the crucial point. In spite of longstanding attempts to plead for the pure rationality of man, history unhesitatingly shows that *such decisions are highly affected by human feelings*. Not even Einstein denied the importance of human feelings and intuition as he said to Max Born in a letter: "*You believe in a God who plays dice, and I in complete law and order.*” At another level we are often frustrated and deeply surprised when we find out that the very existence of human feelings can, so effectively, lay waste to purposeful human behaviour. In other situations modern Western culture quite indiscriminately praises “love” or “religion” to the skies – still upholding the human being to be the exemplar of the rational man.

We must conclude that *a science that cannot account for human feelings will leave out the most important factor of human decision-making* and is probably bound to fail for that very reason. Such a science is almost useless when trying to understand living action and communication as well as living society just because it turn its back upon the genuine and forceful “inner” feelings of living beings.

Life and social sciences cannot do without human feelings and their influences are extensive as already seen. Even today, the misguided realistic (or object-oriented) approach – but with rather few exceptions - captivates the senses of most scientists – especially in the natural sciences. Since science is also - in particular physics – dogmatically based on the *third person perspective* one should therefore expect a radical turn of our scientific thinking when turning to the “internal” or *first person perspective* needed for the development of a science of consciousness and social communication. What we need, to expand the framework of classical science, is to repair its stained reputation. We need a *science, which also reflects g the standpoint of the living being – and the subject-oriented
approach offers such promise. However most of all we must abandon the confusion caused by lingering Cartesian dualism.

Also Prigogine (1996) indicates the wavering dualism embraced by science to be inconsistent:

“Considering ourselves as distinct from the natural world would imply a dualism that is difficult for the modern mind to accept.”

At the same time, contradicting Einstein, he appoints a close connection to the certainty traditionally referred to by classical science and foretells an imminent change:

“Our Mankind is at a turning point, the beginning of a new rationality in which is no longer identified with certitude and probability with ignorance.”

4. The consciousness puzzle and scientific objectivity.

The attempts to develop an understanding of the mind’s organization or consciousness from the standpoint of scientific realism have hitherto failed and have not even shown any promise. For that reason, we will now touch upon this issue and consider the insurmountable problems arising when facing philosophical questions such as:

(i) How can mental phenomena emerge from a purely physical system? (James 1950)
(ii) Where will feelings reside in an analyzed model of a brain? (James 1950)
(iii) Is it possible for physical phenomena in the brain to be influenced by the mind? (James 1950)
(iv) How could an incorporeal phenomenon such as human consciousness manage to emerge from a classical description of reality? (Stapp 1993)

Approaching such questions we must contend that the consciousness puzzle does not fit well into the framework of classical science. The scientists trying to explain the quintessence of organization and living systems revealed in the middle of the 20th century that the classical ideas of strict reductionism couldn’t be applied to these domains – the concept of holism3 was born. This promising idea ought to have become very useful in any science concerned with organizations, interacting entities, agents or the like, but cannot be successfully assimilated by a realistic science so profoundly and irrevocably caught in Cartesian dualism. However holistic thinking has become a catchword mainly because the idea cannot be conceptually handled in the prevailing realistic framework. By now we have abandoned the most naïve ideas of materialism and Laplace’s4 idea of the world as a “predetermined mechanical clockwork”, however recent developments of the super string theory [Green 1999] shows us that many scientists are still trapped in classical reductionism. Newton was an ambitious man and sought nothing more or less than the “system” that paced the world - the Theory of Everything – the physicists of today still believe in this [Barrow 1994]. In spite of the fact that the natural science of today has neither the place for life nor human feelings – oddly enough.

Evidently there is something wrong with classical science and the problems have not disappeared through the emergence of quantum physics as presented today. The questions met with in consciousness studies are so counter-intuitive that the time seems ripe for a radical turnover. The problem of consciousness and human knowledge must be approached from the very fundamentals of

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3 which in fact has become the banner of the systems sciences.

4 “An intellect which at any given moment knew all the forces that animate Nature and the mutual positions of the beings that comprise it, if this intellect were vast enough to submit its data to analysis, could condense into a single formula the movement of the greatest bodies of the universe and that of the lightest atom; for such an intellect nothing could be uncertain and the future just like the past would be present before its eyes.”
science – by asking what is the reason for this counter-intuitiveness. We must reiterate the questions of the great empiricists and in the spirit of D. Hume reconsider the cause-effect phenomenon:

- There is something bewildering about human rationality – do we neglect our intuitions?
- Were there some tacit and hidden assumptions introduced when we developed science?
- Chaos theory has shown scientific determinism was an illusion – are there more illusions?
- The social sciences face a quite different “reality”. How do they cope with the environment?
- Maybe a cross-disciplinary approach such as cybernetics can provide a better understanding?
- Can cybernetics join the social sciences and provide a better basis for understanding?

This is the path we must enter – to call into question the basic principles of science – and I will, without hesitation, propose an affirmative to the answer to the last question. Cybernetics has already sown, not only the seeds of understanding of consciousness, but has also, albeit in the shade of artificial intelligence (AI), already foreshadowed a radical reorientation of human thinking. – It has suggested a constructivist epistemology to expand the ideas of the prevailing, if somewhat misguided, realistic ontology (or materialism if one prefer) in its classical meaning. The feedback mechanism and its appearance both in man and the machine was the phenomenon that inspired Wiener, von Neumann and their colleagues to develop the conceptual framework of cybernetics during the legendary Macy Conferences. Computing machines and the nervous system were on the agenda and pretty soon brainwaves and self-organizing systems also came into focus, catching the interest of many disciplines and also, more especially, representatives from the social sciences. The anthropologist Margaret Mead in this connection said:

“I specifically want to consider the significance of the set of cross-disciplinary ideas which we first called "feed-back" and then called "theological mechanisms" and then called it "cybernetics" – a form of cross-disciplinary thought which made it possible for members of many disciplines to communicate with each other easily in a language which all could understand”.

Contemplating the feedback mechanism, first explicated by the theoreticians of control theory, one realizes that what is essential here is the function of adaptive learning carried out by the feedback signal that is imposed (by neural programming) upon the neural tissues of brain. This signal programs the pathway of perception to produce a useful input to the mind (adaptation), i.e., sort of feedback of knowledge – that makes human perception theory-laden, a term in frequent use in philosophy. The cyberneticians found this “circularity” – sometimes called “causal circularity” in many natural processes and this richness at the conceptual base of cybernetics of course attracted many different scientific disciplines. This adaptive feedback circularity also entered the living mind explaining its learning capacity – but artificial intelligence (AI) took over.

The computer was the reason AI came to dominate the hard sciences and only a handful of researchers stayed loyal to the ideas of cybernetics. Among them H. von Foerster became a major catalyst for the self-organizing idea in the 1950-ties and worked away from the reductionist mainstream ideas – almost obsessed by this idea of circularity. In his own words:

“While this was going on, something strange evolved among the philosophers, the epistemologists and the theoreticians they began to see themselves included in a larger circularity, maybe within the circularity of their own family, or that of their society and culture, or being included in a circularity of even cosmic proportions. What appears to us today most natural to see and to think, was then not only hard, it was even not allowed to think!”

What did they do? They confirmed the ideas of the newly born quantum physics: That the observer must be included in the description of the system observed – but they did so by using a quite different approach!!! Outrageous - because these findings violated the basic principle of scientific discourse that flatly demands the separation of the observer from the observed. The classical principle of “objectivity” clearly spells out: The features of the observer shall not enter the description of his observations.

This dictum has been the scientific ideal since the days of Galileo but in spite of that we have very seldom taken the trouble to ask the following questions:
1. Is it even possible to “objectively” describe (model) a universe independent of the features of the observer?

2. Is it possible to “objectively” describe human consciousness as independent of the features of the observer?

According to the previously mentioned “principle of objectivity” we must describe consciousness from “outside” in order to be objective? Is this really possible? If not what happens to the so highly celebrated scientific “objectivity”?

Are we not caught in a trap? Maybe consciousness is indescribable – or maybe the principle of “objectivity” is somewhat wrongly stated? Maybe the observer must be included in every scientific observation and description? In asking these questions, we once more encounter the “circularity” that once puzzled the cyberneticians. Clearly, when cyberneticians tackled the problem “how do we come to know what we know” they were not only profoundly caught by this “circularity”, they also entered the forbidden land – they were accused of doing non-science.

My claim is that we are deeply caught in a trap – but only by our own classical thinking. Fortunately there is a feasible way out of this embarrassing dilemma called the subject-oriented approach to knowledge. The predicament, as more full presented [Kjellman 2000], is the very reason for the choice of the subject-oriented approach – and I claim it can be resolved by this approach only. However the acceptance is problematic and even today such ideas are met with polemics and stubborn resistance and most people shake their head when meeting the claim that science must (first) be subjective in order to gain the status aimed for by classical “objectivity”. Notwithstanding – in this way we can build a sound consensual science.

The path we must enter upon, in consequence, is to admit the inescapable primacy of subjectivity and from this bright intuition find out that living beings construct their private universes - priverses – inside themselves - of course not in isolation - rather in close communication and coexistence with other human beings. In this way we can restore the forlorn scientific objectivity – not in the form of some observer-independent description but rather in the form of a firmly established scientific consensus. In this way it will soon be seen that we can also explain human consciousness and its role in human evolution – and also find firm ground for reasonable consensus.

5. Looking backwards.

We will now attempt to see how the classical science that replaced the medieval speculations gave rise to this predicament and understand how it was possible for the behaviourist movement to dominate American psychology for six decades. Therefore we must put the clock back to Galileo and Descartes who were both very important founders of the modern scientific methodology. The situation before them was somewhat different to that of today since Aristotle, the exemplary of the Middle Ages, had insisted that science aims not merely to describe phenomena but also to explain them. Explanation, he then went on to identify as the explication of something “deeper”. This led to a view of science as describing the laws of Nature - as opposed to "mere" regularities as they appeared in the mind of the observing scientist. He thereby in a sense referred to Nature to provide the “correct” answer – the truth.

Several medieval philosophers developed Aristotle’s account of the world in depth and because they were also theologians, they were neither content with nor allowed to let Nature provide all the answers to physics. Since mechanics was the main issue in those days they introduced God as the “ultimate mover”. This step was not too difficult, however, as they had to refer to God to provide the answers to ethical questions. It is for these reasons that we must understand why most medieval thinkers insisted on proving the existence of God.

Here is the point where we should pause and also ransack our own scientific thinking. Today we as scientists find the medieval search for God the “great mover” a bit naïve. Notwithstanding the fact that the majority of natural scientists are, in the main, seriously involved in costly projects, dependent on, or looking for, the “ultimate entities of Reality”. In the same vein they are also quite as eager to use Nature as a point of reference when testing the “truthfulness” of the scientific models used. As a
consequence the concept of truth has become the central issue in the realist’s philosophy, as van Fraassen [1] points out:

Science aims to give us, in its theories, a literally true story about what the world is like, and acceptance of a scientific theory involves the belief that it is true. This is the correct statement of scientific realism.

To my mind - and the empiricists – all we, as living beings, have at our disposal are the phenomena of mind. What lies behind these phenomena to provide the answers (at the first level some reality or at some higher level some God that can provide the rest of the answers) is purely hypothetical. We do not wish to say that reality and God do not exist – we just want so say that we, as scientists, do not need such concepts as the conceptual base of our knowledge. My claim is that the question of the truthfulness of the models used in science generally cannot be decided. In spite of their frequent occurrence in philosophy questions such as these must be strictly forbidden in a sound scientific discourse for two reasons: a) they have no answers and b) they cause serious confusion by inviting vain discussions and debates, and are thus supportive of a veritable pseudo-science.

6. The scientific revolution.

In the seventeenth century men such as Galileo, Descartes and later Newton, revolutionized the very nature of scientific activity and this later became firmly established. They selected the concepts science should employ, redefined the goals of scientific activity, and altered the methodology of science. Their reformulation not only imparted unexpected and unprecedented power to science but also bound it indissolubly to mathematics. In fact, their plan practically reduced theoretical science to mathematics. To understand the spirit that animated mathematics from the seventeenth through to the twentieth century, we must not only examine the scientific methodology as laid out by these prominent men – but also, more importantly, take a closer look at how they practised the paradigm of science thus established.

Galileo, to begin with, dismissed the qualitative methodology of the scholastic thinkers and in Il Saggiatore (1627) he described the true methodology of the natural sciences. To liberate science from magic and pure personal speculations he proposed science should avoid the “why” questions and instead concentrate on pure description, i.e., to present “how” things happens. Empirical observation, mathematics and subsequent mathematical modeling were the correct methodology to use in science. We here observe the schema of observation/modeling - an apparently recursive procedure to construct a model of the phenomenon under consideration. After validation such a model was intended for use later when making scientific predictions. This become the ideal of the detached scientific observer – the third person (external) observer – who could reflect on our common reality from outside in order to construct a set of “truthful” models. In this view observation and the human senses work as a camera’s objective – firstly the existence of a common pre-given reality was assumed and secondly this reality was believed to be truthfully mapped, i.e., objectively onto the observer’s mind appearing in the “form” of a mind phenomenon.

Galileo was well aware that some properties were, of course, affected by the human senses. He spoke about the primary and secondary qualities – the latter called the qualities of senses. The very goal of physics now became to describe the world as it really was, i.e., in an “objective” way contrary to the way it appeared in the individual human subjective experience. The sense qualities such as colour, taste, smell and heat were to be omitted – they did not belong to the descriptive world of physics.

It is very important here, to observe the sneaking and tacit reality postulate imposed: There is a unary reality of things with certain properties that are independent of the individual observer. This postulate is in force in any realistic setting - openly declared or tacitly. (Rorty 1980) Even Newton most insistently claiming that science should consistently avoid all unnecessary postulates did not recognize this dubious situation.

The understanding that perceptual interference is not deductively valid, however, is a recent finding of the cognitive sciences, which fully explain why these founders did not understand that existence and knowledge could not be successfully separated. Existence emerges through and from knowledge. Therefore we should perhaps blame this situation on Cartesian dualism, which effectively separated
both matter and body from the mind. In spite of the emergence of quantum mechanics this attitude is, even today, employed, albeit rarely, so maybe we should, for that reason, renounce criticism.

From another point of view Kant (1781) had already claimed that das Ding an Sich, i.e., the things of reality, are hidden from human knowledge. Accepting this Kantian thesis, amounts to the belief *that the reality postulate cannot possibly be falsified*. For that reason it should be banned from the scientific scene according to Popper’s falsification dictum – who in spite of this, was a sworn realist.

Here, from a rather different angle of attack we meet the very nucleus of the subject-oriented approach: *With precaution it avoids the reality postulate – and comes out at the other end with a new definition of objectivity - and of human consciousness as well.* An obstacle, however is that this view also demands a revision of the realistic conceptual framework in use in present day science – and requires the scientist to use a quite different approach to thinking. The subject-oriented approach takes the stance of the observing subject – paying regard to the primacy of its privately collected knowledge. Berkeley’s philosophy also does this and in some respects is very similar to the subject-oriented approach – the latter does not however refer to some deity.

So what was the reason for applying the realist’s postulate? This was of course a pure reaction to the extensive speculations of scholasticism but this idea virtually “threw the baby out with the bathwater”. In the lawful ambition to become “objective” a realistic science introduced this postulate, which effectively shut out human intuition and feelings from the scientific scene – and thereby also human consciousness. Subjectivity became a word of abuse and consciousness studies impossible. On the way there have been visionaries of course, for instance the father of the wave equation of quantum mechanics, E. Schrödinger, who strongly rejected the classical reductionist view that consciousness can be reduced to nervous activity as “intellectually bankrupt”. The first of two “most blatant” contradictions that Schrödinger noted was our surprise at finding our world picture “colourless, cold, and mute.” He claimed we should not be surprised that the feelings we all experience are missing in a world model from which we have removed ourselves.

Nevertheless, physics in the footsteps of Newton and his followers, became the norm for modern scientific activity, with the exclusion of human feelings and intuition from the natural sciences taking on deeper aspects and this very absence of feelings – *subjectivity and feelings became the hallmark of non-scientific activity*. The situation regarding classical science is even worse because *the very moment scientists unfoundedly introduced Nature or God as the key for the extraction of some presumed truths, meant that science was built upon sand*. Considering Galileo’s tragic fate, one comes to understand that there was no other choice.

The ideal of Galileo as described above - the scientific mind and the mind of clarity – became the all-pervading ideal. Science should be performed from the outside by the thus detached and trained observer, who accordingly from a pure third person perspective described the phenomena of the pre-given world (reality) in a set of models (mathematical or verbal). These descriptions could later be approved or not and possibly modified by other scientists and thus purified from possible subjective elements. Today we understand, however, that the process of observation is not actually that straightforward. However, the approach suggested by Galileo has, in parts, been a very successful strategy. Alwyn Scott often said in a course we had together and that: “modeling the mysteries of reality has been extraordinarily successful”. Admittedly - but this approach also has its limitations and a treacherous built-in inadequacy. This is one reason why the scientific study of consciousness seems so elusive – the hard questions pile themselves up and finally they force us to step out of the framework of classical science. This is unfortunately not very easily done – and is often met with a lack of appreciation and sometimes with hostile resistance. Probably this is the result of convenience and paradigmic faithfulness, but we can find guidance and courage to break with tradition by considering another of Al’s saying contemplating the great variety of solutions offered in consciousness studies:

> “when many different suggestions for the solution of a problem are advanced, one suspects that none is very convincing.”

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6 however it does not at all reject the possibility of a common unary reality – contrary to scientific realism this question is left open

7 Modern Science and Mind
7. The predicament of classical science.

The banishment of intuition and human feelings from science was apparently a blind alley. How can we possibly support such a claim when science has proven so successful? The support is given from the fact that the “outside” observer cannot possibly build or describe either a complete or a consistent science since there are numerous phenomena inaccessible to him. Such a science is definitely unable to answer the intriguing questions concerning human nature simply because it leaves inner feelings and drives aside. But even to physics and mathematics this banishment meant inadequacies as most prominently shown by Bell and Gödel’s theorems. The latter showed that Hilbert’s formalist programme was infeasible and Bell that quantum physics is very likely incompatible with the ideas of scientific realism.

The answer to the full question is concealed and all the more surprising. In spite of the frequent declarations and precautions undertaken, science did not become “objective” by the bare denial of human feelings – no in the least. Not even the third person perspective is helpful in that respect – at least not for an observer equipped with a brain supported by feedback knowledge. Instead the intuitions and personal feelings guiding leading scientists could now, in principle, run rampant behind the curtains of scientific “objectivity” – not even the great scientists were faithful to the classical paradigm as spelled out. Luckily – we hasten to declare – since this is probably the main reason for the outstanding success of the natural sciences. The scientists rescued science and mankind by stressing intuition and ingenious creativity – disobedient to the rules of “strict objectivity” they themselves had stated. The eventual idle imaginings emerging were washed away in the discussions and subsequent consensual discourse of science – however the bright lodestar was their own personal feelings and scientific intuition. The astonishing successes of classical science and the enormous impetus to creative work that it derived from that source probably would not have come about if science had faithfully accepted the spelled out Galilean ideal – as a matter of fact he did not himself. On the other hand the declared strive for objectivity on a different level put an end to the frequent unrestricted speculations as practised by the medieval thinkers. The scientific revolution meant an end to speculation in the natural sciences and about the time of Kant we witnessed a separation between philosophy and science that seemed final – however the subject-oriented approach will heal that wound.

Descartes (1641) did not accept the wisdom of Galileo's reliance upon experimentation. The facts of the senses, Descartes said, can only lead to delusions, but reason penetrates such delusions. From the innate general principles supplied by the mind, we can deduce particular phenomena of nature and understand them. Galileo proposed the use of experiments to check the conclusions of his reasoning as well as to acquire basic principles. He, and Newton fifty years later, believed that a few key or critical experiments would yield correct fundamental principles. Moreover, many of Galileo's so-called experiments were really thought-experiments; that is, he relied upon common experience to imagine what would happen if an experiment were performed. He then drew a conclusion as confidently as if he had actually performed the experiment. As a matter of fact he says that he experimented rarely, and then primarily to refute those who did not follow the mathematics. Though Newton performed some famous and ingenious experiments, he too says: “that he used experiments to make his results physically intelligible and to convince the common people.”

For Galileo, as well as for Huygens and Newton, the mathematical part of the scientific enterprise played a greater part than did the experimental. Evidently the men who fashioned modern science approached the study of nature as mathematicians, in their general method and in their concrete investigations. They were primarily speculative thinkers who expected to apprehend broad, deep and immutable mathematical principles either through intuition or through crucial observations and experiments, and then to infer new laws from these fundamental truths of mathematics.

What the great thinkers of the seventeenth century envisaged as the proper procedure for science did indeed prove to be the profitable course. The search for laws of nature produced, at the time of Newton, extremely valuable results based on minute amounts of experimental knowledge – intuition and the brilliance of imagination were the guiding principles. In their deeds they were pronounced subjectivists, establishing the principles of an “objective” natural science – deeply influenced by mathematics and at the same time heavily guided by their feelings and scientific intuition. This is the predicament of classical science as advocated.
8. **Descartes' subjectivity.**

Descartes was an accomplished scientist and mathematician, who laid the foundations for Newtonian mechanics, and revolutionized both number theory and geometry. He proclaimed explicitly that the essence of science was mathematics. The objective world is space solidified, or geometry incarnate. Its properties should therefore be deducible from the principles of geometry. Thus there are two worlds, he claimed: “One, a huge, harmoniously designed mathematical machine existing in space and time, and the other, the world of thinking minds.” While the great philosophical distinction between mind and body in Western thought can be traced to the Greeks, it is to the work of Descartes (1596-1650) that we owe the first systematic account of the mind/body relationship. This solidly established Cartesian dualism has profoundly captivated the senses of most scientists. Descartes' mechanistic philosophy even extended to the functioning of the human body. He believed that the laws of mechanics would explain life in man and animals, and in his work in physiology he used heat, hydraulics, tubes, valves, and the mechanical actions of levers to explain the actions of the body. However, God and the human soul were exempt from mechanism in that sense. Damasio (1994) considers this to be a huge mistake:

> This is Descartes' error: the abyssal separation between body and mind; between the sizable, dimensional, mechanically operated, infinitely divisible body stuff, on the one hand, and the unsizable, undimensioned, un-pushpullable, nondivisible mind stuff; ... Specifically: the separation of the most refined operations of mind from the structure and operation of a biological organism.

Undeniably Descartes separated the human body from the mind in a concession to the mechanistic thinking of his time and by that move he separated the bodily sense impressions and feelings from the human mind – the locus of interaction was the pineal gland. However this was the right thing to do in an age of dawning objectivity. Damasio, on the other hand, insists this amounts to a misunderstanding of biological evolution:

> At some point in evolution, an elementary consciousness began. With that elementary consciousness came a simple mind; with greater complexity of mind came the possibility of thinking and, even later, of using language to communicate and organize thinking better. For us then, in the beginning it was being, and only later was it thinking.

Of course it is no mistake claiming a categorical distinction between body and mind – defining two domains called *res extensa* and *res cogitans* - however the crucial question is in what way knowledge about the entities of these two domains differ. Is the idea of a car different in kind from the idea of my Self – “I”? Claiming a distinction in kind here is troublesome and elusive as Berkeley points out. Damasio is a realist and when he suggests a close connection between body and mind to allow for the feelings he talks about a mind immersed in the body:

> I propose that human reason depends on several brain systems, working in concert across many levels of neuronal organization, rather than on a single brain center. Both "high-level" and "low-level" brain regions, from the prefrontal cortices to the hypothalamus and brain stem, cooperate in the making of reason. The lower levels in the neural edifice of reason are the same ones that regulate the processing of emotions and feelings, along with the body functions necessary for an organism's survival. In turn, these lower levels maintain direct and mutual relationships with virtually every bodily organ, thus placing the body directly within the chain of operations that generate the highest reaches of reasoning, decision making, and, by extension, social behavior and creativity. Emotion, feeling, and biological regulation all play a role in human reason. The lowly orders of our organism are in the loop of high reason.

Also when Descartes was talking about the phenomenology of embodiment – the way we experience the states of our body - he sometimes spoke of the mind being “mixed up with” the body. The properties of spatial position, shape, and size belong to matter, and not to mind. The subject-oriented approach also advocates a similar standpoint – which declares nugatory the realistic viewpoint taken by Damasio – since the mind, body and human environment all are abstract concepts and embraced by human consciousness and knowledge in the subject-oriented approach. This is the only way to build a consensual science consistently (Kjellman 2000). Being a realist Damasio digresses from such a view and this is his very mistake. He continues:
And for us now, as we come into the world and develop, we still begin with being, and only later do we think. We are, and then we think, and we think only inasmuch as we are, since thinking is indeed caused by the structures and operations of being.

and shows that he is held captive by the third person view of classical science. To the knowing individual, from the first person view, life starts with a piece of knowledge – that is not until later developed into the idea of a “self” and its very being. To stay clear of the aberration of classical science here we must make a careful distinction between the conceptions of “epistemological being” and “ontological being” – and understand that “ontological being” is just a working hypothesis conceived by a mankind.

In the subject-oriented approach there is no need to ontologically separate from some mind-stuff – everything is in human (abstract) consciousness and consequently “contained” in a mind as seen from the third person’s perspective. Metaphorically: The “game of life” goes on in my mind only – ideas very similar to Hume’s. Here the traditional world as seen by the individual is a monistic priverse that at first sight appears very “ghostly”. This sentiment, however, goes away when you bang your head against the doorframe. However you do not hit your head against knowledge - you hit your head against the “clues from outside” – the clues that hypothetically are the basis of your knowledge – the working hypothesis. This is so since solipsism seems so unbelievably unreasonable.

9. The quest for certainty and human intuition.

These pondering bring us back to Descartes to see how he tackled the question of human knowledge. “By what method can we justify the claims to certain knowledge, and to the knowledge of necessary and universal truths?” he asked. This was the quest for a philosophy on which our many claims to certain knowledge could be founded. He looked for a method – and found one: The method of doubt. He also looked for the definite proof – and did not succeed - and in 1931 Gödel showed us why.

Descartes began from the question “How can I be certain of what I claim to know?” and immediately his thoughts were turned inwards, to the contents of his own mind and the certainties, which were attached to them. This was his famous method of doubt: He proposed not to accept anything, as valid if there was a reason for thinking it might be false. His method of doubt has led him to seek the very point at which skeptical doubt must cease – i.e., the firm anchor point of human intuition. The doubt was to be overcome by pondering the individual’s thoughts: In the famous phrase “Cognito ergo sum” (I think therefore I am):

“I saw . . . that from the mere fact that I thought of doubting the truth of other things, it followed quite evidently and certainly that I existed” []

This is a central point in his theory of knowledge - and means that to him the thoughts are more certain than the material world – and was more certain than any other’s thoughts. I am able to know what I think, feel, experience, desire, with an authority that you could never match. This is subjectivity at its most extreme – the forgotten foundations of a general theory of (thinking) systems.

This first-person view suggested is not merely a paradigm of private certainty; it seems to show the essence of private human knowledge - what it really and essentially is - through the inner awareness of ‘impressions’ or ‘ideas’.

Whether the source of such knowledge is fancied as a thing of reality, a feeling of a body or a thought in a mind has no bearing on the problem – human knowledge is abstract, i.e., it lacks of extension and human consciousness is the very collection of such private knowledge.

However the Cognito-statement should not be misunderstood. Descartes is not saying that this “I” enjoys ontological existence in the way a car or a person does – not in the least. Descartes’ point is, rather, that even the mental act of doubting, that is to think the proposition “I exist” already secures the existence of “I”. Indeed, any kind of thinking - whether it be doubting, or wondering, or affirming – secures the act of thinking, and the proposition on a mental plane. The crucial point here, which has been absent in most discussions concerning Descartes, is that thinking is a process – and not an object in its traditional meaning. A process is a state-succession and the question where it “takes place” is, in
that respect, subordinate – as a matter of fact a process properly described, can evolve in any embodiment.

The subject-oriented approach is the striking parallel – however here the knowledge of everything is embraced as belonging to a pure mental domain, which was not the idea embraced by Descartes according to most interpreters. So when we are eagerly looking for mistakes in the spirit of Damasio: This is it! Namely Descartes’ categorical definition of an entirely different physical/material domain (res extensa) housing the man’s body and its environment led to the mistake of juxtaposing knowledge of this domain with the domain itself. This gave rise to “Cartesian dualism” an idea has since penetrated most Western thinking.

However one might doubt whether he really entertained the idea himself. Descartes said: It is of my essence to think. However hard I try, I can find nothing else that belongs to my essence. For example, it seems to me that I have a body, which I can move at will; but I can readily conceive of this body as not existing, without supposing my own non-existence. This was probably the reason for the split he made - he was able to doubt his body but not his mind. However this is a distinction in certainty – and not in kind. The mind is certain he says and the body is not – but here he stumbles. The mind is as uncertain as the body – what is certain, however, is the process of thinking. The human thinking process is supported by the mind’s knowledge – but the latter is a working hypothesis only. The feeling of thinking is all that is certain and secures the idea of my mental being – my mental existence. However the latter concept must not be confused with my bodily existence – or the material existence of my mind.

10. Intuitions and the world of extended things

All mental activity, for Descartes, is a form of thinking (cogitatio). Thinking always involves “ideas”, which come before the mind. He said: I perceive ideas that themselves may be more or less ‘clear and distinct’ and he gives the following definition: “I call a perception ‘clear’ when it is present and accessible to the attentive mind. I call a perception ‘distinct’ if, as well as being clear, it is also so sharply separated from all other perceptions that it contains within itself only what is ‘clear’.” What he here seems to have in mind is the idea of a self-evident proposition, i.e., that certain phenomena that come before the mind simply cannot be doubted. In that sense they bear an intrinsic mark of their own certainty - intuitions. The Cogito is one of them, and there are also other propositions that are perceived as “clearly and distinctly” as this one and must also be considered certain. Its certainty is thus revealed not before the “light of human reason” as earlier envisioned – its certainty is revealed in the form of a primary intuition. A primary and “shared” impression so “clear and distinct” that nobody can doubt it or the consensual understanding about it. This is pretty close to Brouwer’s programme, which maintained that the study of mathematics is primary to metaphysics. In the study of mental mathematical constructions he held that “to exist” is synonymously with “to be mentally constructed” i.e., thinkable.

Descartes then goes on to reflect upon the nature of physical things – the bodies of condensed matter – that are also part of the mechanical world - it cannot cease to be extended in space without ceasing to be. Extension belongs to its essence; but he can find nothing else that belongs to its essence. And the same is true of all physical (corporeal) things. Since Descartes so clearly and distinctly perceived that thought is of the essence of mind, and extension of the essence of body he “clearly and distinctly” perceived that mind is essentially distinct from the body and therefore in principle separable from it. This gave rise to Cartesian dualism and from then on the human soul has been hovering around in a nothingness that has been just faintly connected to the “self-evident” physical body of the individual in question in some obscure way – by a modern term the embodied mind. Since then this idea has haunted the majority, with a few exceptions – Berkeley, Mach, Husserl and a few others. However the stimuli from the senses are accordingly accepted and Descartes never explicitly rejects the possibility that the mind could connect to either the outside world or the body. So human feelings are not entirely cut off – just disregarded in the name of objectivity. Descartes was misunderstood, or he otherwise failed, in pointing out that the “idea of a body” has no extension – a point that Berkeley later made very clear.

However, accepting the idea that human consciousness penetrates all the body we understand that any enterprise to separate the human body from the soul/mind is highly deceptive. The reason is that when we disregard human feelings, and their connection to the mind, we also disregard the diffuse
feeling that something is wrong, i.e., human intuition. Since the latter has shown to be the effective
driving force of scientific progress we must promote its use. When accepting the evidence that realism
is indefensible the idea of a veridical truth also vanishes and all that is then left is the reliance on
human feelings and intuition. This is not arbitrariness - rather the only remaining possibility to decide
what is adapted to its purpose (right or wrong) on the grounds of human socio/biological adaptation.
This is the secret path used excessively by the great scientists – for the benefit of mankind we hasten
to say. In full confidence of the feedback learning mechanisms of their brains they took guidance by
intuition and creativity when developing models of the happenings of the fanciful creation we call
Reality. Now we must even regard the very “image” of this fanciful creation to be a sheer model
developed by the human brain and biological evolution hand in hand.

Pondering the ideas as presented here one comes to understand that human feelings were never cut
off from the scientific scene in spite of the “outside” objectivity dictum imposed by classical science -
and can never be. However clinging too persistently to the ideas of realism has prevented us from this
understanding. Feelings must be brought back into the scientific picture and the idea of “objectivity”
in the sense of “outside ness” must be dispatched to the past. What else remains of this conception will
be taken care of by the concept of consensual understanding – which in a sense has been the actual
underpinning of science for a thousand years. In spite of his confessing to realism Damasio agrees:

Feeling is the central topic of this book, and one to which I was drawn not by design
but by necessity, as I struggled to understand the cognitive and neural machinery
behind reasoning and decision making. A second idea in the book, then, is that the
essence of a feeling may not be an elusive mental quality attached to an object, but
rather the direct perception of a specific landscape: that of the body.

This once more shows the importance of scientific intuition and the fact that even the clothing of
misguided realism could not prevent the progress of human cleverness.

The Cogito-statement is also interesting for other reasons; firstly several commentators have
pointed out the role of the word “I” and its obvious self-referential feature – as a matter of fact it is
doubly self-referential. Such statements are immune to error or at least to certain kinds of error called
paradoxes. Secondly and more importantly is that this is a clear first person statement quite contrary to
the third person perspective as imposed by science. Thus here we find a striking subjectivity at the
time of the dawning of the scientific revolution - in spite of its declared paradigm of objectivity. It is
worth noting, however, this is not an “objective” statement in the sense of “outside-ness” as proposed
by classical science – but rather in the sense of a (tacit) consensual understanding, i.e., we can all
agree on the Cognito-statement presented by Descartes – an actual intuition in its consensual sense.

11. A science of consciousness.

Following the path as pointed out above by Descartes, avoiding some sunken rocks, we find a
passable way to build a science of consciousness. Our starting point is the primary phenomena given
in private conscious experience – a first person perspective being dependent on “clear and distinct”
intuitions only. This is also the starting point chosen in the subject-oriented approach - from my
private thinking and its associated mind. Due to the brain’s feedback mechanisms one rock to avoid is:
at any cost avoid the traditional postulate made by classical realism that otherwise will enforce
Cartesian dualism.

We are in good company as the Canadian psychologist Donald Hebb (1949) also rejected dualism
as a scientific distraction. He noted that although dualism cannot be disproved, the role of science is to
proceed on the assumption that it is wrong and see how much progress can be made. In a sense Hebb
asked for a radical and new approach – and my claim is that the subject-oriented approach is a
successful candidate in that respect. Then both Hebb and I are faithful to the dicta of Newton and
Occam: Science should consistently avoid introducing unnecessary postulates!

Also H. von Foerster (1984) who became the father of 2nd order cybernetics explained that its goal
is to explain the observer to himself - or similarly explain science to the scientists - and following this
course he made the bold claim that “reality is a pure mind’s construction”. Also when interpreting the
ideas of von Foerster we find that the basic premise is that human imagination can totally free itself
from the idea of “an objective pre-given observer-independent reality”. This sets one wondering as to
what this was supposed to mean. Mostly one suspects that this was a naive compliancy to the
inheritance of the Stone Age man. This situation surprised even Berkeley (1710):
Some truths are so near and obvious to the mind that a man need only open his eyes to see them. Such I take this important one to be, viz., that all the choir of heaven and furniture of the earth, in a word all those bodies which compose the mighty frame of the world, have not any subsistence without a mind, that their being is to be perceived or known; (Principles, 6)

Maybe Berkeley hoped that people would immediately understand the importance of this claim as he went on:

—it being perfectly unintelligible, and involving all absurdity of abstraction, to attribute to any single part of them [furniture of the earth] an existence independent of a spirit. To be convinced of which, the reader need only reflect, and try to separate in his own thoughts the being of a sensible thing from its being perceived.

Neither the readers nor the scientists were convinced, apparently, since most scientists still stick to the realistic idea that the properties of “furniture of the earth” are observer-independent. Nevertheless Berkeley here makes a central point by discerning “sheer existence” from the “knowledge of it” making clear that we can never correctly, or with certainty, assert the existence of some “material world” because the concept of such a world is “unintelligible”.

The subject-oriented approach is here in full agreement. The existence of a universe can be accepted as a working hypothesis only, but at the very same moment that we regard this construction to be common to all living beings, i.e., pre-given, we are led astray. The “world” as experienced by an individual is a strict private imagination – a priverse - that can be discerned from other “groundless” illusions after great difficulties. The “world” is my knowledge (my working hypothesis) – my priverse. There is certainly no need to assign states or properties to the entities of some “distant and outside” reality and afterwards vainly look for the “collapse of the quantum wave function” to supply a motive for the creation of human knowledge. What Berkeley says is that human knowledge IS in a mind only – the “world” is just a private working hypothesis theoretically (and biologically) constructed to ease human perception and action. This is also what Prigogine calls the “end of certainty” and points out that mankind is at a turning point in which science is no longer identified with certitude – we are absolutely unable to connect to some Reality with definite causal certainty. We can clearly hear the concurrence of Hume (1739). And why this need - after all? There is something peculiar with our obsessive search for the presumed truth.

Maybe this is the very reason that the ideas of Berkeley did not gain a foothold? Or maybe it was that his competitors had even more impressive theories, e.g. Galileo and Newton who, supported by Locke, offered the work-tool of mathematics to handle the theories of the “new sciences.” As a matter of fact Berkeley himself, by making reference to an “Eternal Spirit”, i.e., a God, evidently opposed the ongoing scientific revolution and was accused of turning the clock backwards:

consequently so long as they [the furniture of the earth] are not actually perceived by me, or do not exist in my mind or that of any other created spirit, they must either have no existence at all, or else subsist in the mind of some Eternal Spirit; (Principles, 6)

In several interpretations this is purely a religious statement. In the most naïve ones we can clearly hear suggestions such as: The world does not exist unless perceived by someone. Berkeley therefore asserts a God to “perceive the world” and to make it come into existence. Then God, in some mysterious way, injects the common ideas giving rise to the “mind image of an external reality” into living human beings.

Even if he was a priest this is not at all fair to Berkeley and his views were misunderstood in his own day and frequently still are. To the disappointment of his contemporaries they seemed neither refutable nor believable, and were therefore ignored. After all the most common philosophical reaction to Berkeley’s arguments seems to be: “They cannot be disproved. However this conclusion cannot be right either since we know for certain that there is an external world.” Even philosophers must refrain from creating such absurd situations. When we can neither prove nor disprove Berkeley’s arguments we cannot decide upon the question of their correctness – and we can accordingly draw no conclusion at all except that the very question disqualifies

The conclusion we can draw from these discussions is that the classical idea of a pre-given observer-independent reality or the Berkeleian monistic view can be neither proven nor disproved.
Also on these grounds the meticulous scientist is left with only one alternative – to refrain from the traditional postulate of realism. We must refuse to introduce this standard assertion – and when we advance along this path we can wait until the point where we are forced to do so in order to proceed. By using the subject-oriented approach we will, to our surprise, find that we can build a consensual science without the use of such an assertion at all – that indeed makes this standard assumption very dubious. In doing so we will build a science of consciousness at the same time.

Suggesting such a radical reorientation of Western scientific thinking one might ask what happens to science. Firstly human feelings and the individual’s intuitive grasp of such feelings acquired during a life-long process of learning will be the foundation of such an approach. The concept of truth will radically change for the better and alongside it the rules of logic. The curse of Cartesian dualism is forever dispatched and in the proposed (mental) monistic approach the matter/mind and body/mind-distinction becomes just a categorical one. We are liberated from the straitjacket of living in two worlds – the outside real world and the inside abstract world of our minds, we are liberated from the impossible suggestion of stepping outside of ourselves to have a “detached” look at ourselves. We are once more allowed to be human beings and accept our feelings as they are.

This is not an easy task however since we are so deeply caught in our classical thinking and also partly bewildered by the natural languages we use that are so intimately linked to our world of thoughts. In the discourse of science we normally handle phenomena that are “embraced” by conceptual closures – we call them entities (or the furniture of the earth). These objects are given names and are always located at some place in space/time. Most often they also have some substance and extension and we readily attribute properties to them. In the abstract (mental) domain, however, these entities in a sense fade away but are nevertheless always thought to have some location – in the form of some embodiment. In this vein we speak about the embodied mind – the mind (function) as embraced by the conceptual closure of a body or even more specifically the mind located in the skull of man - physically manifest as the human brain. This is a one-sided view however – and the third person perspective as advocated by classical science. Discussing “existence” for instance we must understand that the conception of “existence” is two-fold: the existence in its physical sense (ontological existence) and existence in its existential sense (the feeling). This is the point where human feelings knock on the door of science.

To break out of the discussions of classical physics, which are in a sense very ontological, we need a language to discuss the science of physics. When we discuss a language and its use, as is well known, we need a meta-language (2nd order language) that can handle the terms of the object language (1st order language). In this way we can discuss mathematics (the understanding of mathematical propositions) and physics (the understanding by physical propositions) by metaphysics. A great deal of misunderstanding has come about by the identification of metaphysics with ontology. However metaphysics is the “study of physical propositions and their interpretation” and since “physical (material) existence” is among those, the ontological questions are often wrongly referred to as metaphysical questions. An ontology is implied in claiming knowledge of what “is” in its physical sense (the ontological significance of being) and is quite different from the “feeling of being”, i.e., its (emotional significance). The latter is very close – if not to say juxtaposes it - to its epistemological significance. The “feeling of being” is most often translated by the term consciousness – with knowing (con scius) – however this feeling is not a feeling of “being” but rather of “knowing”. Embodiments that are able to know have consciousness – physical embodiments that just “are” have no consciousness because they do not need to know. This insight catches one facet of human consciousness.

12. The birth of a consensual non-objective science.

Understandably the “feeling of being” cannot be studied from “outside” and for that reason consciousness studies has, for example, been banned from the arena of science. In this vein natural sciences have also often claimed that human sciences are non-scientific just because they are not “objective” – a supposed (but unfortunately undefined) property assigned to the natural sciences since the days of Galileo. We have seen this is not the case and natural scientists themselves have not followed that dictum. So when the natural scientist approaches the question of human mind he does so from the third person perspective – looking for an embodied mind and its location trying to explain its neural activity. The human skin will always act as a visual barrier and therefore the question of

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location becomes very obscure. The mind is solely the third person’s perspective of the functioning of the human brain.

When we want to study the “feeling of being”, on the other hand, we must take the first person’s perspective into account and this is not easily done since we are not trained to do so. After some training one comes to understand that the “feeling of being” is called human “consciousness” and this phenomenon can only be “felt” from the first person’s perspective. One might feel that science has very little experience of using this perspective – but on further considerations one understands that human beings have an immense experience of this perspective and since science is performed by human beings there should be a rather large body of knowledge even in this area – even if it is not yet fully legitimate.

This is not the place to enter into the question as to how to achieve the conceptual experience of the first person perspective – but just as a remark – this prospect is quite straightforward:

Close your eyes and open them all of a sudden. There you are! Ponder your impressions and thoughts – your consciousness is all-embracing and has no location at all. When you open your eyes you are literally assaulted by your all-embracing priverse – the fragile and unique construction of your mind and the very instrument panel of your life.

This suggests your consciousness is a mental awareness rather than in a material world; thus consciousness is not a thing and has no definite location. As a matter of fact the human mind is better considered to be spread out all over the human body.” Such proposals are now emerging increasingly often and let us here consider Damasio’s:

Further, I propose that human reason depends on several brain systems, working in concert across many levels of neuronal organization, rather than on a single brain center. Both "high-level" and "low-level" brain regions, from the prefrontal cortices to the hypothalamus and brain stem, cooperate in the making of reason. Both "high-level" and "low-level" brain regions, from the prefrontal cortices to the hypothalamus and brain stem, cooperate in the making of reason.

This is also in accord with Schrödinger’s (1958) idea, who found a contradiction in what was seen as our fruitless search for the locus of the mind: “Since our objective world has been constructed by removing our mind from it, we should not be surprised not to find it there.”

In his award-winning bestseller “The Society of Minds” Marwin Minsky (1988) also find reasons to scatter the mind all over the human body (a third person’s perspective of course) proposing it to work like a human society. For a cybernetician working hand in hand with systems science such a suggestion seems quite natural and following this line we are today able to pinpoint the similarity to an abstract business organization. Human consciousness here is the chief executive receiving reports from the subordinated units in a hierarchy – the mind [Kjellman 2001]. Thus the whole perceptual path may be seen as comprising the multi-ordered sub-assemblies as proposed by Hebb. In this way, perhaps, one can explain how the preceding sub-assemblies - programmed by feedback - adjust perceptual phenomena rising in the consciousness. The business organization analogy of mind is an attractive extension of the ideas as proposed by both Hebb and Minsky.

13. Can we rely on human intuition?

Modern science did not succeed in removing the observer’s mind from the picture – fortunately. The scientific observer as proposed by classical science led to great successes but this was not due to clarity of mind – rather to the trust in the human mind as part of a successful biological evolution. When this fact was pointed out by the early cyberneticians nobody was even willing to listen and this answer was sadly forgotten. The reason for this successful adaptation of human brains is the feedback function of the human mind – which effects all human perception. Modern cognitive sciences forcefully argue that sense-experience cannot be regarded as possible in the absence of beliefs about the realm over which it ranges. Saying that perception is ‘theory-laden’ sometimes makes this point; it is permeated with beliefs and concepts without which it could not be considered as perception, but

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8 However we must understand mind is a construct to be used in the third person perspective whereas and consciousness should be used in the first person perspective.
merely as uninterrupted stimulation of the sensory pathways. Let us see how previously gathered knowledge can affect the happenings in the sensory pathways of the brain. We understand, in principle, that this must be some sort of feedback mechanism – the functioning of this mechanism is easily recognized in the following sketchy figure (fig. 1), which portrays the knowledge feedback of an artifact called the one-channeled observer:

Contemplating this figure we come to understand that in the case where there is an effective knowledge feedback in place we have no means of reconstructing the signal (stimuli pattern) before the senses – which in a sense gives a special new meaning to das Ding an Sich and its inaccessibility. We can never reconstruct the input – so what then is the point of claiming knowledge of some Reality? All there is – are the phenomena of mind and what is going on is because of the laws of mind – certainly not the laws of nature. Hume’s skepticism was very well founded. As a matter of fact through this figure we can envision solipsism very easily by disregarding the sensory input. At the very moment the human brain is connected by feedback loops the reconstruction task is impossible – we cannot possibly reconstruct the incident signal. The human imagination that we call perception has to rely on pure construction – constructivism.

There is strong evidence that there are numerous feedback loops in the human brain. Alwyn Scott (1995) devotes several chapters discussing this idea. Hebb’s assembly theory provides a credible general model of the brain’s dynamics that can be combined with the negative feedback principle emphasized by N. Wiener in his formulation of cybernetics. Also Erich Harth (1993) sees global positive feedback as a means of selective amplification: a new and important idea. To realize such properties, Scott continues, Harth suggests that positive feedback operating on a global scale is required and it seems appropriate to include his creative loop among the means available for the brain to use in creating the knowledge feedback of its mind.

The figure also reveals that perception must be constructed to take place in mind and not as generally believed in the human senses. As a matter of fact the whole perceptual path from the senses to the central awareness can be seen as a row of observer agents who are part of a row of multi-ordered sub-assemblies as most prominently proposed by Hebb. In this way we can explain how the preceding sub-assemblies are programmed by the feedback phenomena of control theory to adjust perceptual phenomena arising in consciousness.

Scott has also drawn my attention to the obvious parallel with H. Stapp (1993):

From this perspective, the brain is seen as a hierarchical sequence of measuring devices for which the wave packet collapse can occur at any level: synapse, axon, neuron, or whatever. Stapp chooses the highest level of the brain’s dynamical activity and associates making the cut with a conscious act. Conscious events are assumed to be the “feels” of these top-level events, which actualize macroscopic patterns of neural activity.
Most optical illusions occurring in the cognitive sciences can be explained by reference to fig. 1. The realistic (object-oriented approach) movement has to explain why the postulated reality is “similar” to the mind phenomena – they do this by means of a “mapping procedure” – reality is mapped onto the mind. This explanation breaks down totally when accepting the idea of feedback loops in the human brain. In the subject-oriented approach – as in phenomenology - there are just the phenomena. We explain the assiduous feeling of the “things-out-there” by means of the mind’s outward projection – as suggested by Velmans (fig.1), a mechanism long well known in psychology.

In this view there is no need of a pre-given reality – and we can accordingly avoid being trapped by such a postulation. We now understand that to explain the success of human prediction ability there is no need of a reality. All we need is a set of useful models. In the same way that human beings create their “unseen” social reality and learn to adapt to it we can now also extend the idea to the reality domain. The human mind is the reality creator. At the precise moment that we reject the idea of a pre-given reality the door opens up to show us the role of human consciousness as the reality creator. The phenomena occurring in the mind are nothing other than biological model creations to supply the deciding mind with a set of input data for important decisions.

These remarks also terminate the embarrassment of empiricism – which under the shadow of realism, is accused of advocating a philosophy lacking a world-view [Fraassen 1994]. I claim here that we see the two crucial differences between realism and empiricism (I prefer the dichotomy object-oriented/subject-oriented approach). Firstly realism claims science is the discovery of a pre-given (real) world – but empiricism claims the “apparent world” is a construction erected from outside clues. Secondly realism claims that each attempted model comes closer to some “truth of nature”. Empiricism denies that there is such a truth to find - simply because truth is nothing other than the outcome of a decision procedure – which, as such, is in need of some sort of reference. The subject-oriented approach takes another step and virtually “internalizes” all points of reference, opening the door for any well-trained scientist to make a useful decision – in that respect one can claim that any statement made is self-referential – making a reference to his/her own knowledge body.

In this view the source of our knowledge cannot be traced with any certainty to some outside phenomenon (entity) – the certainty of classical science is gone forever as claimed by Priogine. This is also what Hume once claimed and in this new situation we have no other option but to rely on human intuition, i.e., put our trust in the fact that our brains are fit for the knowledge acquisition of life. In this situation we can certainly not cripple our brains by banning the “inner” feelings – in this situation these are the only instruments of decision. Not because we have grown selfish – but purely for the reason that we believe in the fitness of evolution and the connected-ness of the body and mind/soul as suggested by Damasio. When the mind/soul is immersed in the body we are about to heal the wound created by modern dualism – and we can then start to build a holistic science based on consensual understanding that can replace the misguided objectivity of modern realism.


The property of “objectivity”, held in high regard and often attributed to science and the expert decision-makers, can be and often is misused. In everyday use it has become a self-styled manner to disqualify the arguments of one’s opponents. No human being can become “objective” nor can human science – just because the idea of an “objective reality” is erected upon the idea of a pre-given and observer-independent reality, i.e., the reality as seen by some deity. This unfounded and needless postulate is the very backbone of realism – and by its removal we can once more admit human feelings and officially restore faith in human scientific intuition.

The subject-oriented approach to understanding claims that the prevailing physical realism is a misunderstanding. It is said that this has led mankind to a point of unimagined technological achievements and at the same time onto a technologically inspired path of materialism that empowers ruthless exploitation in any guise – trends that are undiscerningly supported by the modern media industry.

The discovery of the feedback loops of the brain by the early cyberneticians – and present day work on neural networks – supports the classical idea that human perception is theory-laden. Such advancement leaves no room for classical realism. In this setting the search for the absolute truth is as vain as it is pointless to assign absolute states to some “predefined objects of the world”. Human knowledge is all there is – emerging only in a living mind. Many terms lose their “inborn taste of
objectivity”; they all reduce to collective common (consensual) agreements where the natural and social sciences conflate. Measurements, perceptual impressions and inner feelings become nothing more than subjective facts to be treated at the same level of experience — it is just the choice of concepts, tools and measuring sticks that makes a difference.

The physicist’s can go on using the stiff measuring sticks they are used to, however we must understand that they represent most of all human feelings. The meter stick reduces to the “feeling of the meter stick” – yellow to the “feeling of yellow” and headache to the “feeling of pain in the head”. The path to take is to reduce the physical (object-oriented) concepts into human (subject-oriented) concepts, i.e., feelings to come to a consensual understanding.

The two factors appointed here a) the subjective feeling (the vital /gravitational?/ force of sociology) b) the feedback loop (of cybernetics) are the reason why the subject-oriented approach to knowledge has emerged in the setting of “sociocybernetics”. More correctly we can state that the feedback loops of the brain make the quest for classical certainty impossible – and the new base for scientific security (or rather probability) must be derived from a conceptual base of human intuitions worked out in genuine consensual understanding.

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