STIG STENHOLM

The Quest for Reality

BOHR AND WITTGENSTEIN

Two Complementary Views

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PRELUDE: THE MODERN STANCE

1.1. A time of change

Philosophie dürften man eigentlich nur dichten[1]

The centre cannot hold[2]

Medieval man lived in a universe of certainty. The Church delivered truth, nay it was the only truth. If one queried science or issues of conduct, the scholars could provide an answer. This was always to be found in Aristotle or the Church fathers respectively. Deviations from this received judgement were incinerated in the auto-da-fé, consuming both the individuals as well as their writings. No deviating answers emerged because the questions could not be asked.

The first break in this bulwark was caused by science. The movement initiated by Galileo Galilei could not be stemmed and eventually deprived the Church of its authority in scientific matters. The process was slow but its outcome was inevitable. Sustained by progress in technology, modern physics and chemistry proved their worth.

Concomitantly with the scientific developments, the reformations ended the supreme sovereignty of the Catholic Church and opened up the freedom of the individual to think. The French Revolution finally put its seal on modernity; even in the matter of administration, the popular opinions of the crowd could no longer be neglected. The modern society is still living as the heir to these movements.

But physics did not provide the ordered world expected of it; nor did any brand of democracy lead to the *greatest happiness for the largest number of people.* All that happened was that we were thrown into a state of perplexity, which only grew with increasing knowledge. The increase of knowledge certainly did not increase happiness.

In science, the mastering of heat engines and electricity forged the foundations for most of modern technology. It was, consequently, expected that the phenomena of nature could be catalogued and chained. Things did not turn out this way; the ultimate theory of matter and radiation, quantum theory, took the form of an abstract set of recipes, which gave no basis for a visualizable picture of everything. Still the theory has been profoundly successful when applied to real

[1] L. Wittgenstein, *Vermischte Bemerkungen.*
[2] W. B. Yates, *The Second Coming.*

phenomena; both technology and fundamental understanding have benefitted enormously. But it has not solved any riddle of our lives nor revealed the essence of the empirical world.

When philosophy aimed at certainty it turned to mathematics. Surely, it was taught, the result of a calculation is necessarily true. The statement "The circumference of a circle is π times its diameter" has to be an absolute truth. But no, the arbitrariness of Euclidean geometry made the statement undecided at best. With a closer investigation, more difficulties emerged: How do we assign a numerical value to the diagonal line and the curved line of the circle itself; how do we compare these numbers? What is that mysterious symbol "π" and what is its status of being; how are its digits determined and what is their distribution?

In addition to the questions of defining the mathematical concepts and their mutual relations, there turned out to be unavoidable features of incompleteness. Not all theorems can be proved and not all numbers can be computed. These results do, of course, refer only to formal processes in closely defined systems, but they suggest a need to doubt the truth and relevance of mathematical manipulations.

The consequence of these complications turned out to be the insight that all knowledge must be captured in words belonging to our common language. Because this is not a closed formal structure, it is dependent on human life in the everyday world. It contains limitations deriving from our limited intellect and historical developments as social beings. There can be no universal language game describing all of reality including human consciousness. The use of language works only in limited situations and in incomplete ways.

Ludwig Wittgenstein started his thinking by trying to provide a complete description of all that can be stated uniquely in language. The rest cannot be discussed and thus lies outside of communication. He thought that he had finished the task of philosophy, which thus had reached its ultimate end. Later he recognized that language is more intricate than he had assumed. His subsequent work was to be based on communication within limited systems, considered as language games in which concepts have their meaning. Even the activity of mathematicians falls into this category of games.

In physics, Niels Bohr came to be the advocate of a new approach to the physical investigation of reality. He recognized that the theories of physics also derive their communicative power from the use of language, even if we need to extend it with the tools of mathematics. This is then to be taken as complementing our common language. The theory is purely formal, and communication has to be conducted in terms of classical concepts, because these apply to the world where we live. The only way to make the exchange of physical information unambiguous is to extract classical pictures from the processes of nature. According to Bohr, the full description from initial preparation to final recording of the outcome, is the basic *physical phenomenon*. This is the unit of description, just as Wittgenstein's language game is his playground for meaningful communication.

I have singled out Wittgenstein and Bohr for a comparison, because they represent the best examples of the modern approach to the fuzziness resulting from progress in understanding the human position in the world. Each one had to replace apparent order and certainty by an understanding based on limited concepts in constant flux.

Bohr and Wittgenstein worked in very different fields and locations. I certainly do not claim that they influenced each other directly; they may not even have known about each other. Their parallel endeavors derive from the cultural atmosphere of all civilized Europe. They reacted in their separate characteristic ways to the prevailing zeitgeist. Hence their achievements are symptoms not mutual causes. And still, their influence on their contemporaries became unforeseeably large. This is part of the magic they radiated into the realms of their activities.

Bohr and Wittgenstein are complementary in treating human communication from abstract formalism to empirical methods. But both realized that the problem lies not in nature nor in our scientific methods but in our use of language. This implies that they even tend to use identical ways to express themselves.

Niels Bohr:

We are suspended in language in such a way that we cannot say what is up and what is down.

Ludwig Wittgenstein:

We are struggling with language.

This defines the tools, the goal can only be defined by a poet [1]:

> What are the roots that clutch,
> what branches grow out of this stony rubbish?
> Son of man.
> You cannot say, or guess, for you know only
> A heap of broken images, where the sun beats.

1.1.1. Outline of argument

The aim of my writing is to consider the breakdown of a certain world view during the twentieth century. This is mirrored in the treatment both of science and philosophy. As these form the foundation of the human position in the world, a major reorganization of the body of knowledge had to take place. I have chosen Bohr and Wittgenstein as the main actors to represent this revision. My conclusion is that the modern synthesis is far from satisfactory. By leaving the story unfinished in its present state, I hope to provoke a renewal of the discussion and the eventual emergence of a reformed clarity and understanding. Reality is to be left as it is, but the human mind is also to be left as it is. The problem is to find a way to effect a harmonious combination of these.

The content of this book is essentially one argument. However, because it encompasses such a broad range of human activities, it will consist in various pieces which together, hopefully, suggest the unified picture I aim at.

Chapter 1: The modern stance

This outlines the motivation I have had for undertaking this work. I also argue that, acknowledging the remarkable progress of science, it is essential to dissect the modern world view from the aspects of physics. The physicist may be the outsider here, but he may also bring new light on a confusing situation. In order to combine the thinking in physics with that of philosophy, I choose to deal with the lives and achievements of Bohr and Wittgenstein in some detail.

The total analysis is based on my personal experience and subjective feelings; it thus remains a fiction: *The Myth of Physics and the World.* Only when definite conclusions are someday reached, will it be the time for formal analysis and tracing of roots. For the moment we are not yet there.

Chapter 2: Twilight of the gods

Here I describe the loss of intellectual certainty characterizing the nineteenth century. Vienna as well as Copenhagen was dominated by the cloud of despair characterizing the period between the Napoleonic Wars and the disastrous First World War. In spite of all progress, the former catastrophe created an atmosphere designed to anticipate the second one. In retrospect, many symptoms of this were to be seen, but the most influential one was, no doubt, the emergence of the Dane Søren Kierkegaard. In his native Copenhagen he initiated the existentialist movement influencing all Europe, and he was well known in Vienna at Wittgenstein's time.

Chapter 3: The view from Copenhagen

This summarizes the life and work of Niels Bohr. It presents his view of modern physics and possible influences on him, and the impact of his activities. In particular, I discuss the role of his philosophy mentor Høffding and colleague Rosenfeld. Finally I compare Bohr's approach to the *pragmatism* of William James.

Chapter 4: Epistemological interlude

In this Chapter, I summarize my personal view of existence as a human being in empirical reality. Much is speculative and many things are highly subjective. However, I consider it intellectually honest to inform the readers about my own standing. This bias may induce me to superimpose my views on those I present later. It should be up to the reader to decide to what extent Bohr and Wittgenstein support my approach. This chapter treats: epistemology, consciousness, language, and the methods of science. All these form central issues in the later discussions, and this introductory story should be conceived as a preliminary background. In conclusion it states that what we experience of nature, is never

enough to lay down the basic elements of reality and their essences. Metaphysics is empirically underdetermined but essential for a harmonious world view.

Chapter 5: Wittgenstein enters the scene

Here I summarize the life and achievements of Wittgenstein. I trace the philosophical background of his activity, stressing especially the role of Boltzmann. Wittgenstein never became his student but was, obviously, strongly influenced by him. I also contend that the opinions of Boltzmann were very similar to those of pragmatism, even if it is highly unlikely that Boltzmann knew any works by William James. Here I also summarize the conventional description of Wittgenstein's thoughts, the early and the later ones. There are, in fact, lots of similarities between them: Wittgenstein's problems remained largely the same, but the early certainty was replaced by an extensive skepticism and feeling of helplessness in view of the immense problems offered by life and logic. The chapter is concluded by the discussion on *Certainty* originating from lectures delivered by the philosopher George Edward Moore.

Chapter 6: Shaky foundations

Here I summarize the effort to reach absolute certainty in mathematics. This endeavor ended in failure, because no absolute truths can be found even in formal systems. The underdetermination of all such systems is taken to imply that not even the best theory can reach an absolute truth. In view of this, Wittgenstein devotes a lot of discussion to the very activity of doing mathematics: What can we know and what can we do even without a solid foundation? If the world of mathematics is posited, what life can live and develop in this world?

Chapter 7: Physics interface

It is argued that the *Tractatus* is an analogy of the classical description of physical reality. We know that this had to be replaced by the much more ephemeral quantum theory. It is argued that many of the features of Wittgenstein's later work could have been applied to quantum physics, if only he had known about this. The argument at some points refers directly to modern physics in a way Wittgenstein could not have done; he did not know modern science.

Chapter 8: Philosophical consequences

We return to the issue of pragmatism and its relevance to modern physics. It is argued that Husserl's *Phenomenology* is the last attempt of nineteenth-century thinking to impose conventional order on the realm of philosophy and its manifestations in our empirical picture of reality. I argue that this enterprise failed, and after this the European continental philosophers confined themselves to the world of human life and its written products. Thus *existentialism* has given up the attempt to understand and control the real environment. This separates them unequivocally from the philosophy of science in any of its possible forms.

Chapter 9: Metaphysics and reality

Here I discuss the implications deriving from the epistemology that has served science so well. Our technical mastery of the empirical world still does not uniquely determine either the ontology of the ultimate reality or the potential interdependences of it elements. What we can know we may know, but our understanding allows, nay demands, that there are things we cannot know. Thus we are free to populate these posited worlds as we like, assuming only that we do not create inner contradictions into our fantasies or external conflicts with empirical facts as we know them. This situation leaves open the opportunities even to incorporate religious arguments. To avoid misunderstanding: religious concepts are in no way implicated by our knowledge but, on the other hand, it cannot exclude them. It is pointed out that Wittgenstein was apt to refer to God, especially in his early writings.

Chapter 10: Concluding epilogue

This chapter comments on the opinions presented. I concede that many arguments presented have been expressed earlier; only the combination of issues may offer a novel perspective. However, a detailed declaration of relations to other works would only have proved lengthy and boring. The writing itself is supposed to convey the necessary information to the reader.

I am aiming at exhibiting an impression of the worlds of reality as seen from a position of modern science. The result is multifariously different from a strictly analytic formulation. I am fully aware that the text satisfies neither the formal requirements of academic philosophy nor the deductive logic of physical theories. It is a hazy view, but it suggests to me the existence of a thing of beauty, the human participation in reality.

Consequently there is no attempt to include a complete list of references. If each statement and each quotation had been referred to its proper place in the literature, the text would have been cluttered with notes and remarks, seriously hampering the reading. Thus only essential sources are indicated.

1.2. Certainty lost

The quest for certainty in philosophy has left a feeling of dissatisfaction. Here I am trying to present a vision or a program. Thus I have to speak a lot about things one cannot speak about according to the philosophers. But I have to, this is part of the problem.

The progress of philosophy during this century has been most impressive. However, when all is said and done, and a lot has been said indeed, we are left rather unsatisfied. The grandiose program to systematize mathematical knowledge ended up in an incompleteness theorem, and the ambitious positivistic effort to construct the world from sense data collapsed under its own immensity [2]. Philosophy itself seems to have abandoned all high expectations and in various postmodernistic forms joined the arts in a struggle for ingenuity and

originality but forgetting goals related to reality and relevance. This will not do; if philosophy is not to become a fringe of knowledge dealing in verbal acrobatics only, it must return to its original tasks of making sense of our best understanding of reality and elucidating our role as humans in the world of being.

This century is characterized by a huge expansion in our scientific knowledge. Chemistry and physics have entirely altered our everyday surroundings as well as our view of the Universe. One may question which aspect is more significant for human life, but that does not change the situation. Molecular biology tells us how we become what we are, and the theory of evolution why. Empirical science is also gaining more and more information about the working of our brains, and the questions about the character and mode of existence of consciousness are again allowed in a scientific discourse [3]. Many details are still obscure, but there is no denying that the world where the educated man lives today is vastly different from that of our forefathers only a hundred years ago.

But this huge leap in our knowledge has not really reformed the process of philosophical thinking. The modern analytic school started as an attempt to understand mathematics as being the most rational of human activities. The result seems to be that its complexity and very essence are too incomprehensible to allow any universal conclusions. The attempt failed, but the methods and goals of this approach have survived as "the method" of philosophy. It has been applied to other fields of so-called exact sciences: astronomy, physics, and chemistry. These produce numbers, thus creating an illusion of exactness. However, the competent practitioner knows well how many approximations go into even the best of theoretical predictions.

Most of the traditional philosophy of science is based on the classical disciplines of physics, which are easier to comprehend than the modern quantum physics and field theory. These are very abstract, and their very mode of existence is dubious. We simply do not know enough! When such theories have been analyzed by philosophers, very sensational conclusions have been reached: they can be made to support both anti-realist interpretations of knowledge [4] and mystic views of the unity of everything [5]. Little useful insight has emerged, and it seems that these theoretical structures cannot be analyzed fruitfully by the methods of present philosophy.

However, philosophy must remain a human enterprise. It must follow the development of our best knowledge and its impact on society and the individual. Thus it must take a phenomenological starting point and admit the facts of existing reality. If we want to create a philosophical understanding of our world, we must start with science, even if philosophy may have other goals too, which need a different point of view. The methods developed to understand mathematics have been found not to work here; they did not really work for mathematics either. The certainty envisaged by Descartes was not to be found. The fact that physics deals in numbers does not make it a part of mathematics. It is an ongoing attempt to describe reality using the tools of our language, which are hopelessly inadequate to the task even if, as Bohr puts it, they are

supplemented by the language of classical physics [6]. There is no safety in numbers, nor in anything else. Philosophy cannot make progress if it does not abandon its requirements of rigor and certainty and joins the natural sciences in their uncertain and groping search for partial truths and reasonable conclusions. The progress in science has proved that this can be done without giving up the ideals of increasing verisimilitude and growing comprehension.

As active scientists we tacitly assume the reality and existence of the objects of our inquiry. No philosophy can change that.

But how can we know that reality exists? At the dawn of the twentieth century, Ernst Mach [7] explicitely denied the reality of the then emerging microscopic world:

> The moment we begin to operate with mere things of thought like atoms and molecules, which from their very nature can never be made the objects of sensuous contemplation, we are under no obligations whatever to think of them as standing in spatial relationships which are peculiar to the Euclidean three-dimensional space of our sensuous experience.

However, science presupposes some brand of reality. As the archmaterialist Lenin succinctly expresses it:

> The scientists will also have to answer this question unhesitatingly; and they do invariably answer it in the affirmative, just as they unhesitatingly recognize that nature existed prior to man and prior to organic matter.

The Russian attitude to Quantum Theory will be discussed below.

Another answer is that we all live as if a real world existed. Even the most ardent anti-realist philosopher steps aside when a fast car is approaching; he does not stop to analyze his sense impression or the mode of being of the car. How do we know that other humans exist? Because we see them behave as we do and describe their own experience just as we do ours. These statements cannot be made certain; they are based on common sense. But any other sense is far less common.

We may thus start our discourse from the observation that human individuals live in the world, act in purposeful ways, and react meaningfully to external occurrences. We may infer that they are engaged in an activity we call thinking, even when we do not know all that this implies.

1.2.1. Algorithmic or analogical thinking?

The dominating influence computers have on our society today has led to a tendency to pattern all understanding on the manner of operation of the digital data processor. This holds not only in the sciences but equally in linguistic and social inquiries. All intellectual activity is supposed to be modelled on the algorithmic way a computer deals with data. But the computer is basically a very primitive contraption, and it may be a mistake to take its construction as the paradigm of our theoretical effort to understand reality.

The mode of operation of a computer has been formalized in the concept of a *Turing device*. This is the universal computer, which can emulate the

operation of all classical ones. As such it can be subjected to logical analysis, and the limitations of logical systems apply to its capabilities. In particular, the incompleteness theorems associated with the name of Gödel have their computational counterparts: not even all well-formulated tasks are computable. This occurs even for some problems where we, the humans, seem to know the answers. Penrose [8] takes this as proof that the human mind does not operate algebraically; there are intuitive truths which can not be computed on a Turing device.

It seems that Penrose's conclusion is going too far; what is known and what is not in an algebraic system depends on the formal structures encompassed. All proofs work only within these systems, and their authority to say something about reality is questionable. Only a Platonic interpretation of necessary relations between formal systems and external reality could confirm such authority on them, and the validity of such an interpretation is just part of the problem we are trying to elucidate. The Penrose argument is clearly circular.

But the fact remains that humans are good at making propitious decisions in a complex and ever-changing world. The human mind is an excellent machine for drawing useful conclusions from insufficient information. It seems highly implausible to derive this property from an algorithmic model of the working of the mind.

There is, however, a different way of obtaining solutions to problems, the analog computation. This has been nearly forgotten in this age of digital processing, but its characteristic feature is to get acceptable overall solutions without being able to achieve any feats of extreme accuracy. A good analog model is fast and retains the essential features of the situation, but it cannot iterate through many steps without losing its precision. It requires continuous feedback from the environment and updating of its inputs. Analog methods are, however, known to be able to solve problems not amenable to numerical treatments.

Here it may be objected that an analog device can be emulated on a digital computer. This is true but essentially irrelevant. The digital solution is based on a mathematical formulation of the problem, which can then be translated into a numerical algorithm. It does not prove that the original method was algorithmic. For instance, a complicated boundary value problem can be solved simply by making a wire frame of the shape of the boundary and dipping it into a soap solution. I fail to see how this procedure could be considered algorithmic.

The seemingly eerie ability of the mind to surmise correct solutions may derive from an analog activity. Then we can retain a materialistic view of thinking without hitting the limitations of algorithmic processes. The brain consists of a complicated, highly interconnected, and extremely parallelized data processing unit. In this case the distinction between digital and analog processing blurs. Its activity may well be based on manipulating the information in an analog manner by pattern matching, associative combinations, and emotional steering. This may allow fast and efficient decisions which would work for all practical purposes. It would provide what we are used to call intuition.

1.2.2. Pictures in the head

The approach outlined above brings back the metaphysical nightmare of ideas as images in our minds. It has to assume that we possess structures in the nervous system which are maps of various features of reality. The mapping may be rather complicated; our conscious categories of space and shape may well be coded totally differently in the mind. The images are not only descriptions of the objects and their relations and properties, but they may also contain much more abstract webs of relations connecting them to our social and professional situation. All features of reality which have a bearing on our well-being and activities must be mirrored in the structure of the mind.

We have no theoretical model of such imaging systems, but to me they seem no less likely than any corresponding digital maps. And some representation of reality in the mind is necessary to explain our behavior in the world. Brain physiological research gives ever more evidence of the complex interconnection between our bodily and mental activities. On the other hand, Jungian psychology has provided the concept of Archtypes in the mind [9]. These are common structures we humans possess, they are genetically conditioned, developed by language, and enforced by society. They may well be manifestations of the innate structures of the mind, as these emerge through the methodological tools of analytic psychology.

How is it possible that our minds contain images of these complex features of reality? Such a correspondence between our internal and external worlds may seem purely metaphysical until we remember that we are what we are because of biological evolution. Humans, including their mental apparatus, are the endpoints of a Darwinian process, which has served to make the individuals fit to live in their environment. The details of this process are too complex to be fully understood, but there prevails a general consensus about the basic facts.

It seems reasonable to think that the evolution process has impressed visions of the surrounding reality on the human mind. The ability to learn must contain the same trends, so that education and growing up add further images of the complex systems we encounter in nature and society. Both the history of mankind and the trial and error of the individual life serve to eliminate grossly incorrect conceptions of reality. The learning process is highly flexible allowing totally new skills to emerge. There can be no genetic disposition to learn driving a car in a congested urban area. Furthermore, if the human mind can learn to feel at home in N-dimensional topological spaces and solve tasks there, how can we doubt the existence of images of surroundings much more necessary for survival?

1.2.3. Language and mind

In some sense we have returned to Kant, the description we have of reality is determined by the categories of our mind. But we have a different emphasis, the categories utilized by our knowledge are shaped by reality as experienced by humankind. They are adapted by evolution and learned by living. We have

an incomplete, fractured, but highly interconnected representation of external reality in our minds.

When we act, we can draw directly on our inner images, but if we wish to communicate about them we have to resort to language. This is an attempt to map the inner images on the structures provided by language. Thus a verbal description is twice removed from the reality it tries to convey; no wonder it is imperfect. It is understood only on the basis of an underlying common life experience and a principle of charity; in similar situations people are expected to have similar impressions, obtain similar associations, and have similar reactions. Here any cultural differences may introduce difficulties; one need not think of the anthropologist in an isolated tribe, but even the discussions between physicists and biologists are sometimes bizarre enough.

This brings us to Wittgenstein's idea of language as a picture of the world [10]. He abandoned this view himself, which action may well be justified by the difficulty of catching the multifarious features of reality in a linguistic framework. The situation changes, however, if we assume that the verbal expression tries to be a picture of an inner representation of reality. This is already a symbolic representation, even if we do not know how the coding operates. Thus it makes much more sense to interpret the language pictures of Wittgenstein's *Tractatus* as representations of such inner images of the speaker. These constitute his impression of the external world, but they are also conditioned by all other features making up the individual speaking. Any information conveyed depends on a common language, a common life experience, and a common biological inheritance. It still holds that: "Wovon man nicht sprechen kann, darüber muss man schweigen." [3] Inside a human there is much one cannot speak about.

Our approach thus admits that we build up our image of the environment using the categories available to the mind, and we can only communicate them to others if our language contains the means to do so. Where both Kant and Wittgenstein go wrong is in their conviction that these limitations remain constant. Evolution and training can teach us to experience things not accessible to our forefathers, and languages can develop to contain expressions not earlier needed. The progress of science has led to a desire to incorporate large parts of mathematics into the common language, but this only serves to illustrate the process. Even the logically offensive quantum theory can be the subject of meaningful and rational discourse.

The images we have in our minds have been shaped by reality and thus they must contain genuine features of the structures and interrelations in the external world. We have thus direct access to such information, and utilizing all the innate understanding life and evolution have given us, we may be in a position to start the endeavor envisaged by Plato and Descartes, namely to try to understand the nature of reality, the workings of our minds, and the fact that they depend on each other. This is what philosophers call the *problem of intention*; how can

[3] What we cannot speak about, we must pass over in silence.

features of the mind represent objects in the outer world? Much relevant data have been collected by science, but a new "method" to approach these problems has not even started to emerge.

Surprisingly, the view we have reached seems to agree well with both ancient philosophy and modern counterintuitive features of quantum theory. Even in those simple situations where quantum physics can be applied theoretically and tested empirically, the phenomena contain amazing nonlocal correlations and holistic dependences, which are in direct conflict with the simpleminded classical view of reality. Philosophers have long warned us that this view is an illusion, but quantum theory cannot be taken as the final verification of the unreality of the external world. After all, the concepts and rules of the theory have been extracted from purely empirical circumstances; they have been forced on us by the world itself. To take the theory as proof of its unreality constitutes a circular argument.

The conclusions proposed in this text sound highly mystical. If that is what they are, so be it; mysticism is just a label and need not be taken in a pejorative sense.

But the arguments used in this book are clearly metaphysical. If such arguments are to be excluded, then I have nothing to say. It is, however, my strong conviction that no deeper understanding of reality can be gained without entering metaphysics. In fact, I would even say that those arguing that they can manage without metaphysical assumptions are simply deceiving themselves. The problem is that their assumptions are either hidden or simplistic, mostly both. We cannot talk about reality, empirical or theoretical, without metaphysical presumptions. Nature is neither an abstract mathematical structure nor a human construct. I strongly feel that, if a future philosophy is to contribute to our understanding of reality and man's place in it, one cannot continue to neglect those aspects of our common human endeavor which are expressed here. In this book I am trying to capture the essence of the human experience as it has emerged during the twentieth century. Both physics and philosophy have met with immense progress and bitter disappointments. But from contortion agility is born.

1.2.4. The whiff of truth

Truth is one of the most used (and misused) concepts of philosophy. The situation is simple in a well-ordered world, where each object is identifiable and all its properties are uniquely verifiable. We may then list all objects of the world and the relations (*Sachverhalten* according to Wittgenstein) they take part in. The truth of a statement is decided by a simple correspondence test; it is true if it is in agreement with the state pertaining to the real world.

However, such a simple situation as outlined above does not seem to be attainable even in the realm of classical epistemology. Modern linguistics and especially modern physics seem to make the simple situation described an illusion. There may be no fundamental objects constituting the world and their

defining characteristics may be inseparable from their role as actors in forming the totality of being. Thus *truth* needs to be reconsidered; there is no absolute concept of truth that can be read off the appearance of reality even including the human interpreter.

The logical concept of "truth" was institutionalized by Alfred Tarski, who formulated the rules needed to introduce truth into formal languages pertaining to logic. This work has become a cornerstone for the analysis of truth, but it depends on an ambience of a formal language, and thus it carries no implications for the analysis of the real existence of the world. It helps us check the consistency of the concept of truth when one is offered to us, but it gives no method to look for it. David Donaldson has attempted to extend this to the ordinary language used in everyday communication, but there seems to be no consensus that his approach exhausts the topic.

The present analysis derives from the starting point that truth may mean different things in different types of discourse. The opposite of "true love" may be "false love" but this concept has but little in common with "false money" or "faithless husbands". *Truth comes in flavours.* The obvious question is then: how many flavours are there? Instinctively one may say that there are infinitely many, but that statement is not very helpful. In this writing I will try to analyze what I believe is a main division. Most instances of the application of the attribute "true" falls under one of these categories.

Like flavours, truth comes in three categories: sweet, salty, and bitter. I analyze them one by one:

Sweet truth

Mathematical truth which can be proved within a system. Form a sentence according to the syntax of your system and logically independent. As a consequence of Gödel's theorem, any such sentence can be assigned a provable truth value, true or false; in some cases only if the axiomatic system or the tools for proofs are suitably extended. The impact of such truth on reality is questionable. Outside its formal framework it lacks consequences. There seems to be no limit to the amount of mathematical truth possible. It is not known if, in a Platonic sense, there exists a maximal set of mathematical truth. Personally I doubt it.

Salty truth

Situations which "everybody" agrees to be manifest. These are the direct observational sentences that at one time were supposed to constitute the "sense impressions" from which a world is to be built. We agree that there is an apple on the table, I see that the bottle is empty, and my technical device shows the numeral 12.5. The truth here is that we see the apple, we notice the emptiness of the bottle, and the meter shows 12.5; these states of the matter prevail. The experience is true, because we (somehow) manage to eliminate the possibility of an illusion. I also leave out the question whether all observers agree on the same experience, but for the present purpose this may be assumed. What these

"truths" say about the external world is not true or false in a formal sense. They require an interpretation which falls outside the present category. Take the statement "The bottle is empty." I say that at dinner, the other guests may or may not agree, but as an absolute statement about the world, it is not unambiguously relevant. Is it really a bottle, and if it is, is it empty, and how can we test if it is so? All these questions depend on material circumstances, and it is not obvious that the concepts utilized have meaning in the appropriate context.

Bitter truth

Statements which acquire their warranted assertibility from the prevailing level of scientific knowledge. In Newton's time it was true to state that the motion of planets is determined by his law of gravitation; today this is approximately true only. At Bohr's time, the atomic nucleus consisted of protons and neutrons, but then no true statements about quarks were possible. That quantum objects can appear as waves or particles is true, but the question about their nature cannot be formulated at the present level of science. Each meaningful scientific statement about the world may be true or false within its limits of applicability, but it is not, and presumably will never be, absolutely true or false. Water is a liquid, but it is also H_2O, depending on the context of the use of the statement. Even universal concepts like *Laws of Nature* cannot be true or false; they can only be valid as approximately verified.

1.3. Declaration of intent

1.3.1. Role of philosophy

An essential question for all humans is the meaning of our existence and the existence of the external world of experience. Traditionally such ponderings have belonged to the hazily defined discipline of philosophy. However, during the progress of scientific inquiry, philosophy has had to adjust to the emerging mass of accumulated facts, because it can obtain its legitimacy only by resting on accepted truth. On the other hand, it remains controversial to decide what constitutes established truth. Thus we are back at a question belonging to the realm of philosophy. Thus empiricism and human interpretation of its products have progressed hand in hand, causing conflicts but also creating concepts to be utilized by the other side.

At the dawn of the twentieth century, the emergence of modern physics was strongly influenced by philosophical considerations. Both Einstein and Heisenberg produced their revolutionary results under the influence of positivistic trends. *Only that can exist which allows for an operational interpretation.* Later developments have passed beyond this puristic approach, but the associated physical achievements have remained valid. So something true must have emerged from the argument.

Later developments have estranged philosophy and the developments of modern physics. Both parties are here, in my opinion, to blame. Physics has been blinded by its own success; the progress in experimental technique and the massive achievements of commercial applications have made the physicists overlook the absurd world view offered by quantum theory.

Philosophy has been of no help here, it has shunned the hard questions concerning reality and turned to logistic formalism, philosophy of everyday phenomena or pure linguistic pettiness. This way academic philosophy has turned away from its duty to build a conceptual framework for the exploration of physical reality. The situation has become such that leading physicists have turned their back on all philosophy. A characteristic example is the detailed argumentation of the Nobel Laureate Steven Weinberg [11]:

> I do not even mean to deny all value to the philosophy of science, which at its best seems to me a pleasing gloss on the history and discoveries of science. But we should not expect it to provide today's scientists with any useful guidance how to go about their work or about what they are likely to find.

The weird character of quantum knowledge has, however, initiated a movement to understand the whys and hows of the grossly successful quantum theory. Today it is again permissible to ask questions about its foundations and the character of physical knowledge. Philosophy is back on the stage; whether it can help us to push physics beyond its present stalemate remains to be seen.

We need to reconsider both the epistemological stand of scientific inquiry and the ontological implications of the ever-so-successful modern physics. Fundamental analysis needs to be resurrected while considering the progress in empirical science. Whatever reality is, its empirical manifestations must be mirrored in our thinking. This is no preconceived view of what we expect to find, but a part of the method of our discourse.

If we want to progress beyond our present state of human understanding, we must evade all indoctrination from earlier thinking. We must consider the play anew. We must regard the empirical world, its impression on our minds, and the relation between these as a natural phenomenon to be described and studied. In this book I attempt to lay the foundations for such an activity.

It may be claimed that such audacity indicates hubris in a high degree. Especially as philosophers are as lax to admit any influence from natural science as ever the physicists with respect to philosophy. Our multifariously eminent philosopher G. H. von Wright repeatedly stresses [12]:

> I find particularly distasteful the kind of "holiday thinking" in which scientists—some of great stature in their professional field—sometimes indulge in order to express their nonprofessional views on the "big questions": on the nature of mind and matter, on the meaning of life, or on the divine hand of nature. At the risk of being accused of professional conceit, I should say that whereas there are good examples of successful amateurs in science, I cannot think of any in philosophy.