

# Subjects, Objects, Data and Values

*by Robert M Pirsig*

The title of what I have to say today is "Subjects, Objects, Data and Values." It concerns the central theme of this conference — the meeting of art and science. Science is all about subjects and objects and particularly data, but it excludes values. Art is concerned primarily with values but doesn't really pay much attention to scientific data and sometimes excludes objects. My own work is concerned with a Metaphysics of Quality that can cross over this division with a single overall rational framework.

When I sent in the title of this paper in February I hadn't written this paper yet and so I kept the title very general to allow myself plenty of room. Now the paper is finished and I can add a subtitle that is more specific. The subtitle is, "Some Connections Between the Metaphysics of Quality and Niels Bohr's Philosophy of Complementarity." As I see it, Bohr's Complementarity and the Metaphysics of Quality stand midway between Einstein and Magritte. I have concentrated on Bohr's work as a way of making the larger connection.

I want to start with a famous conference that occurred here in Brussels in October 1927. It was the Fifth Physical Conference of the Solvay Institute. Here is a brief account of what happened, described by Bohr's biographer, Ruth Moore:

Bohr and Einstein were there, "as well as nearly all others who were contributing to theoretical physics. Lawrence Bragg and Arthur Compton came from the United States. DeBroglie, Born, Heisenberg, and Schrodinger all were to speak on the formulation of the quantum theory.

"The subject was 'Electrons and Photons.' To leave no doubt that it was directed to the main question, the theme embroiling all of physics, discussion was centered around the renunciation of certainty implied in the new methods [of physics] ... Bohr was invited to give the conference a report on the epistemological problems confronting quantum physics. By asking him to speak on the science of knowledge and the grounds for it, the conference gave him full opportunity to present Complementarity. There was no avoidance; the issue had to be directly faced.

"Excitement mounted as Einstein rose to speak. He did not keep them long in suspense. He did not like uncertainty. He did not like the abandonment of 'reality'. He did not think Complementarity was an acceptable solution, or a necessary one. 'The weakness of the theory lies in the fact that on the one hand, no closer connection with the wave concept is obtainable,' he said, 'and on the other hand that it leaves to chance the time and the direction of the elementary processes.'

"A dozen physicists were shouting in a dozen languages for the floor. Individual arguments were breaking out in all parts of the room. Lorentz, who was residing pounded to restore order. He fought to keep the discussion within the bounds of amity and order. But so great was the noise and the commotion that Ehrenfest slipped up to the blackboard, erased some of the figures that filled it, and wrote: "The Lord did there confound the language of all the earth."

"As the embattled physicists suddenly recognized the reference to the confusion of languages that beset the building of the tower of Babel, a roar of laughter went up. The first round had ended." (Moore 164)

The conference was carried on in events but also in private meetings and personal conversations with "thought experiments" carried out where physical conditions were imagined and results were predicted on the basis of known scientific facts. Behind the thought experiments was an all-important question of scientific certainty. Bohr was saying that the particles that constitute our material universe can only be described in terms of statistical probability and never in terms of absolute certainty. He regarded the development of the quantum revolution as in a certain sense "complete." Quantum theory need no longer await some enlightening revelation that would put everything right from a classical point of view.

Einstein wasn't having any of it. Quantum theory was not complete, he said. The universe is not ultimately a set of statistics. It was at one of those meetings that Einstein asked his famous question, "Do you really believe God resorts to dice playing?"

Thus began the controversy over Complementarity that continued for the rest of Bohr's life. It seems that I have heard about this famous schism all my life and wondered what it was about but never thought I would ever study it because I have no background in physics or mathematics. However, after my second book *Lila* came out in 1991 a friend in Norway wrote me that there was some attention being paid to *Lila* in Copenhagen by followers of Niels Bohr. It was suggested that the Metaphysics of Quality was similar to the Copenhagen Interpretation of the Quantum Theory 1. That sounded like good news to me and something I should look into. When similarities of this sort exist, they can either be an odd coincidence or they can be evidence that both systems of thought are describing something that is true independently of either thinker. Where the approaches are very different each can sometimes throw new light on the other. So when the invitation came to speak here I decided to make it the topic of today's paper. If the Copenhagen Interpretation, which is a dominant explanation of quantum theory today, agrees with the Metaphysics of Quality and if the Metaphysics of Quality is a correct theory of art, then there may be here a unified theory of art and science. Einstein will have met Magritte and the purpose of this conference will have been to some extent fulfilled.

## **Quantum theory**

The first thing I discovered is that the volume of literature on quantum theory is enormous, and to a non-mathematician much of it is inscrutable. Physicists who do try to explain quantum theory in common language point out what a terrible burden it is to try to discuss it in non-mathematical terms. For me, a non-mathematician, it is also a burden to deal with secondary sources on the problem without knowing what the original mathematical language means. But there are two aspects to quantum theory: the mathematics of quantum theory and the philosophy of quantum theory. They are very deeply separated. The first seems to work very well. The second does not seem to work very well. Most physicists use the mathematics of the quantum theory with complete confidence and completely ignore the philosophy. I'm going to reverse that and concentrate on the philosophy and bypass the math. I have been working almost entirely from secondary sources and have placed heaviest reliance on a book by Henry J. Folsom called *The Philosophy of Niels Bohr*. I have read that there are many variations of the Copenhagen Interpretation and Bohr's philosophy of Complementarity is only one of them. But it is the first and to simplify matters I have stayed with it alone.

For those of you who are as unfamiliar with quantum physics as I am I'll try to give a minimum summary here of what brought things to this state of conflict in 1927:

Before 1900 there existed in physics a problem known as "the ultra-violet catastrophe." Radiation from black bodies was not behaving according to predictions. In 1900 Max Planck solved this problem by theorizing that the radiant energy was coming in packets, rather than in a continuous flow. In 1905 Einstein saw that light was doing the same thing and named these packets "quanta." In 1913 Niels Bohr, who had developed the most widely accepted picture of the atom at that time, saw that a description of the way these quanta behaved also fitted the behavior of the electron in the atom.

With this new picture of the universe came a number of paradoxes: the disappearance of space-time locality, the abandonment of causality, and the contradictory appearance of atomic matter as both particles and waves.

The record of the period just before the conference of 1927 is best given by physicist Werner Heisenberg who worked with Bohr on this problem:

"I remember discussions with Bohr which went through many hours till very late at night and ended almost in despair, and when at the end of the discussion I went alone for a walk in the neighboring park I repeated to myself again and again the question: "Can nature possibly be as absurd as it seemed to us in these atomic experiments?" (Heisenberg 42)

At another point Heisenberg said, "When you speak about the model, you mean something which can only be described by means of classical physics. As soon as you go away from classical physics, then, in a strict sense you don't even know what a model could possibly mean because then the words haven't got any meaning any more. Now this was a dilemma.... Bohr tried to keep the picture while at the same time omitting classical mechanics. He tried to keep the words and the pictures without keeping the meanings of the words of the pictures. Both things are possible in such a situation because your words don't really tackle the things any more. You can't get hold of the things by means of your words, so what shall you do?... Bohr's escape would be into the philosophy of things." (qtd in Folsom 111)

Heisenberg remembers, "Those paradoxes were so in the center of his mind that he just couldn't imagine that anybody could find an answer to the paradoxes, even having the nicest mathematical scheme in the world.... The very strange

situation was that now by coming nearer and nearer to the solution the paradoxes became worse and worse. That was the main experience.... nobody could know an answer to the question, 'Is an electron now a wave or is it a particle, and how does it behave if I do this or that and so on.' Therefore the paradoxes became so much more pronounced in that time.... only by coming nearer and nearer to the real thing to see that the paradoxes by no means disappeared but on the contrary got worse and worse because they turn out more clearly.... like a chemist who tries to concentrate his poison more and more from some kind of solution, we tried to concentrate the poison of the paradox" (qtd in Folse 85)

Heisenberg said, "Bohr was more worried than anybody about the inconsistencies of quantum theory. So he tried really to understand what is behind these difficulties.... Bohr really suffered from it, and Bohr couldn't talk of anything else.... He in some ways directly suffered from this impossibility to penetrate into this very unanschaulich, unreasonable behavior of nature.... But that was Bohr's whole philosophical attitude — he was a man who really always wanted to get the last degree of clarity. He would never stop before the end.... Bohr would follow the thing to the very end, just to the point where he was just at the wall.... He did see that the whole theory was on the one hand extremely successful, and on the other hand was fundamentally wrong. And that was a contradiction which was very difficult to bear, especially for a man who had formulated the theory. So he was in a continuous inner discussion about the problem. He always worried 'what has happened?'" (qtd. in Folse 36-37)

### **Bohr, Heisenberg and concepts of reality**

During this early development of quantum theory there appeared a disagreement between Bohr and Heisenberg that is important to notice. Heisenberg was satisfied that the mathematical solution, matrix mechanics, gave all the understanding of atomic systems that was needed. Verbal pictures of what was going on were not necessary. Classical theoretical notions as "objects" are no more than conceptual instruments for predicting successfully the outcome of various experiments.

Heisenberg said, "Well, we have a consistent mathematical scheme and this consistent mathematical scheme tells us everything which can be observed. Nothing is in nature which cannot be described by this scheme.... Since classical physics is not true there, why should we stick so much to these concepts? Why not say just that we cannot use these concepts with a high degree of precision.... and therefore we have to abandon the classical concepts to a certain extent. When we get beyond this range of the classical theory we must realize that our words don't fit. They don't really get a hold in the physical reality and therefore a new mathematical scheme is just as good as anything because the new mathematical scheme then tells what may be there and what may not be there." (qtd in Folse 94)

This early view of Heisenberg's is, I understand, the view of most physicists today. If the mathematics works who needs the philosophy? But Bohr did not agree at all with this view.

Bohr saw that the quantum theory's mathematical formulation had to have a connection to the cultural world of everyday life in which the experiments are performed. If that connection were not made there would be no way to run an experiment that would prove whether a quantum prediction was true or not. Quantum theory must be verified by classical concepts that refer to observable properties of nature.

Heisenberg remembers, ".... Sometimes Bohr and I would disagree because I would say, 'Well I'm convinced that this is the solution already.' Bohr would say, 'No there you come into a contradiction.' Then sometimes I had the impression that Bohr really tried to lead me onto Glatteis, onto slippery ground, in order to prove that I had not the solution. But, this was, of course, exactly what he had to do from his point of view. It was perfectly correct. He was also perfectly correct in saying, 'So long as it is possible that you get onto slippery ground, then it means that we have not understood the theory.'" (qtd, in Folse 86-87)

Heisenberg said the controversy was so intense, "I remember that it ended with my breaking out into tears because I just couldn't stand this pressure from Bohr." (qtd in Jammer 65) But Heisenberg concluded, ".... just by these discussions with Bohr I learned that the thing which I in some way attempted could not be done. That is one cannot go entirely away from the old words because one has to talk about something .... So I could realize that I could not avoid using these weak terms which we always have used for many years in order to describe what I see. So I saw that in order to describe phenomena one needs a language.... The terms don't get hold of the phenomena, but still, to some extent they do. I realized, in the process of these discussions with Bohr, how desperate the situation is. On the one hand we knew that our concepts don't work, and on the other hand we have nothing except the concepts with which we could talk about what we see.... I think this tension you just have to take; you can't avoid it. That was perhaps the strongest experience of these months." (qtd in Folse 96)

## The language problem

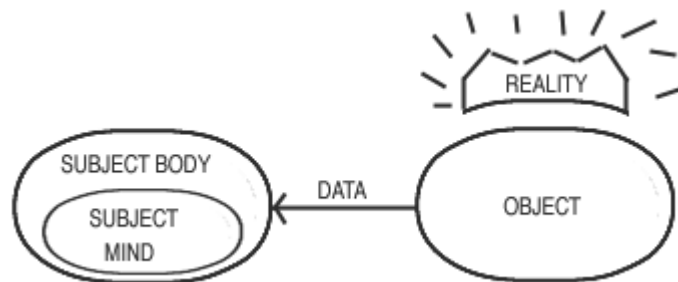
As I read these statements it occurred to me that the tension that Heisenberg referred to still exists to day and may be in part the reason for this conference here in Brussels this week. Although scientists have great problems in their work with the use of the every day language of literature and the arts, they cannot do without it.

When Bohr formulated his philosophy of Complementarity that was what he was trying to do — find a common ground between the new quantum theory and the language of everyday life. It was this effort that Einstein attacked here in Brussels in October 1927. Bohr was really caught in the middle between anti-realists like Heisenberg who said, forget the philosophy and the realists like Einstein who said, if you stay with statistics without specifying what it means in terms of real external objects, then you are leaving reality behind.

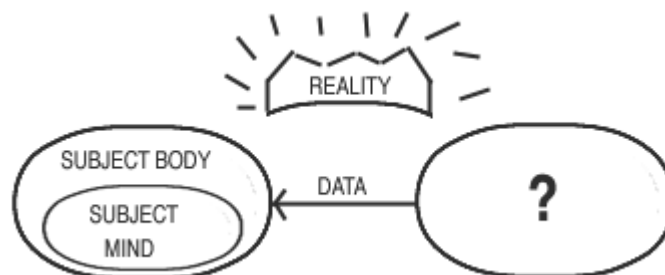
The debate was always in terms of thought experiments. Although Bohr had said, "Reality is a term we must learn to use," the debate was never raised to the level of a discussion of what this "physical reality" is whose description is either complete or incomplete. The reason may be that in those days a philosophic discussion of "reality" was greatly discouraged. Discussions of reality were metaphysics and metaphysics was something associated with medieval religious mysticism. Yet as I read through the material even I could see that this was not primarily a quarrel about physics, it was about metaphysics. And I saw that others had noted that too 2. There is no way one can possibly construct a scientific experiment to determine whether or not an external reality exists if there is a difference in metaphysical interpretation. Whatever results you come up with can still be explained differently in each metaphysical system.

## Complementarity

So now it is time to get into a closer look at the metaphysical system of Complementarity itself. As almost everyone comments, it is not easy to understand. I have been over the materials dozens of times and still am not at all sure I have it completely right. I want to show some simple diagrams first to make it clearer.

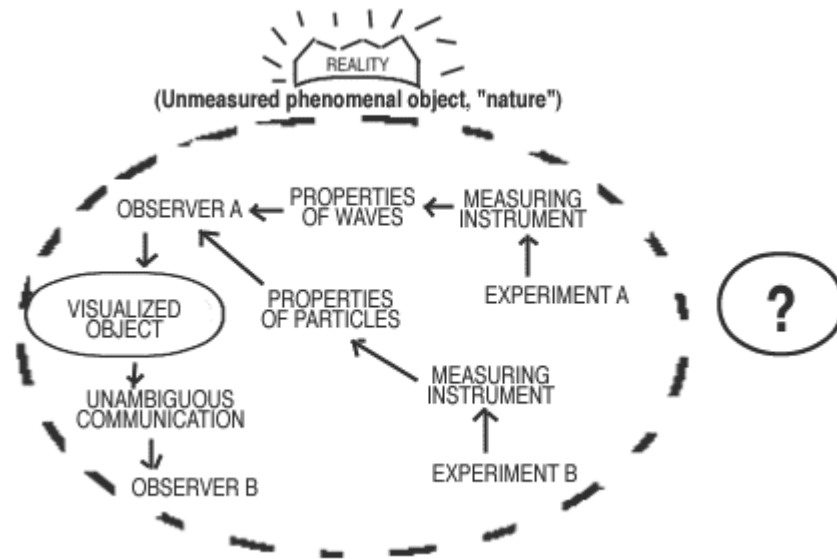


This first drawing represents the classical view of science. We are the subject. The external world is the object. We study the object with measuring instruments to collect data about the object, work with logic and math on this data and develop a theory to explain what this object really is. This view is so well known to us today we think of it as common sense. If there were time it would be valuable to get into the history of how this view came into being. In 400 of the last 500 years it has worked with enormous success. It is only in the last hundred years or so that our measurements are showing that the objects we are studying are apparently impossible. Since the phenomena from the measurements are not about to change, Bohr concluded that the logic of science must change to accommodate them. Here is the second diagram



I found Complementarity easier to understand when I describe it in two steps, of which this is the first. There is a shift in reality shown here from the object to the data. This view known as phenomenalism, says that what we really observe is not the object. What we really observe is only data. This philosophy of science is associated with Ernst Mach and the

positivists. Einstein did not like it and assumed Bohr shared it, but Bohr did not reject objectivity completely. He did not care so much which philosophical camp he was in, he was mainly concerned with whether Complementarity provided an adequate description to go with the quantum theory. In this third diagram we get down to the details of Complementarity.



This diagram is not anything Bohr generated. It is something I have assembled myself and although I have revised it many times I would still expect Bohr to find things wrong with it, and others too who are more familiar with this subject than I am. But it is the best I can do. Bohr saw the Complementarity that is diagramed here a way of solving many paradoxes but the wave-particle paradox he seems to have given the most attention to and I will use this paradox only.

First, notice that within this phenomenal object all things are together except the visualized object that is surrounded by an inner oval. There is no sharp exclusion of the observer from the observation. There is no sharp distinction of the measuring instrument from the experiment. The whole phenomenon is treated as one big observational interaction in which the distinction between observing system and observed phenomenal object is clear but is arbitrary.

Second, notice that on the right hand side of this larger oval there are two experiments: Experiment A and Experiment B. From Experiment A the observer observes waves. From Experiment B the observer observes particles. The experiments never put these two together. It is wrong to say that the experiments are on the same object or on any object at all. It is wrong to say that waves or particles are there before the experiment takes place. We can never say what goes into the experiment. We can only comment on what comes out.

Third, notice that when observer A observes experiment A and then, at another time, he observes experiment B, he may afterward in his mind combine the results of experiment A and experiment B to produce a "visualized" or "idealized" object. This visual object is a sort of mental collage created by the observer. Experiment A and Experiment B have been combined in a Complementarity for his philosophy.

Fourth, notice that this "visualized" object, that now may be called "light," is both waves and particles. Its description is what we must mean when we speak of objectivity. When Bohr says " It is wrong to think that the task of physics is to find out how nature is. Physics concerns what we can say about nature." (Herbert p45) He means that this visualized object is all we can talk about. It is an abstraction, but there is no other object. There is no "deep reality."

Fifth, notice that observer A then communicates this visualized object in an unambiguous way to observer B. By "unambiguous" is meant that A communicates it through a mathematical formalism combined with a word picture. All measuring equipment must be included in an unambiguous description. Later observer B can run his own experiment using the same measuring instruments and testing conditions to confirm the unambiguous communication from observer A. The proved unambiguity of this communication verifies the true objectivity of A's visualized object.

It can now be said that, because of this way of understanding things, a truly objective description has been given of light as both waves and particles without involving nature in a contradiction.

Finally, notice that this largest oval, the unmeasured phenomenal object shown with the dashed line, contains everything that Bohr talks about. He never discusses the old physical reality shown with the question mark off to the right that is external to this unmeasured phenomenal object. But, more importantly, he never mentions this larger oval, this

unmeasured phenomenal object itself, presumably because to do so would be meaningless. It has no properties. The properties result only from the experiment that occurs within this oval. I have made this oval with a dashed line because I have a feeling Bohr wouldn't approve of it. But I think this larger unmeasured phenomenal object with the dashed line has to be there because if it were not there the only thing the experiments would be measuring is the measuring instruments themselves. Though Bohr doesn't describe it, something as to go into the front end of each experiment. I may be missing something but I don't see how you can have an experiment where nothing goes in but phenomena come out. Bohr may say that what goes in the front end of the experiment is "meaningless" and by the use of that term invite us to never think of it at all. But there has to be something going in whether it is meaningless or not. I make this point now because I will be coming to it later.

It has been said that neither Einstein nor Bohr seemed explicitly aware that although they conducted their dispute in terms of thought experiments, the dispute is nevertheless about metaphysics. The metaphysical issue at the root of it all is the old mind-versus matter issue, the subject-versus-object issue that has dogged philosophy since the days of Isaac Newton and David Hume and Immanuel Kant.

## **Subjectivity**

Bohr's Complementarity was accused of being subjectivistic. If the world is composed of subjects and objects, and if Bohr says the properties of the atom are not in the objects, then Bohr is saying that the properties of the atom are in the subject. But if there is one thing science cannot be it is subjective. You cannot seriously say that science is all in your head. However in his early writing on Complementarity that is what Bohr seemed to be saying. (Folse 24) Bohr was trying to work out a problem in quantum physics, not just juggle a lot of philosophic categories, and Henry Folse says it didn't seem to occur to him what the implications of this might be. In his first paper on Complementarity Bohr made no mention of objectivity and actually made the gross mistake of calling his Complementarity subjective. He also spoke of scientific observation as "disturbing the phenomenon" which suggested that either he was talking about thoughts disturbing objects or else talking about phenomena being subjective.

Given this attack on his subjectivity it can be seen why Bohr developed the concepts of "phenomenal object" and "visual object" as independent of the subject in the diagram I have just shown you. He was constantly under pressure to prove that what he was talking about was not subjective.

His repeated argument is that Complementarity is not subjective because it provides unambiguous communication. When the results of the experiment exist unambiguously in the mind of several scientists Bohr says it is no longer subjective.

However, in my own opinion, that still doesn't get him out of the charge of subjectivity. When Bohr says the test of objective, scientific truth is "unambiguous communication" he is saying that it is not nature but society that ultimately decides what is true. But a society is not an objective entity. As anthropologists well know, societies are subjective too. The only truly objective aspects of "unambiguous communication" are the brain circuits that produce it; the larynx; the sound waves or other media that carry it; the ear drum, and the brain circuits that receive it. These can process falsehood just as easily as truth.

Folse says that Bohr never overcame the criticism that his philosophy was subjectivistic. "Bohr had envisioned Complementarity spreading out into wider and wider fields, just as the mechanical approach of Galileo had started in astronomy and simple phenomena of motion and gradually spread to all of the physical science." (Folse 168) But that never happened. Quantum physics dominates the scientific scene today but not because of Bohr's philosophy of Complementarity. It dominates because the mathematical formalisms of quantum theory correctly predict atomic phenomena.

Bohr was disappointed all his life by what he regarded as the failure of philosophers to understand Complementarity. Except for William James he "felt that philosophers were very odd people who really were lost." (Folse 44) Late in his life he remarked, "I think it would be reasonable to say that no man who is called a philosopher really understands what is meant by the Complementary descriptions." And as Folse concludes, "that somewhat wistful comment by this great pioneer of modern atomic theory is sadly true today as it was over fifty years ago." (Folse 44) Although Bohr had intended to write a book that contained and developed his philosophical ideas he never wrote it. This leads me to think that he realized his philosophy wasn't working the way he hoped it would but didn't know what to do about it. He talked as though he was sure it was right but was frustrated and disappointed that it never seemed to have caught on with others.

Henry Folse said that, "in what was to be his last interview, the day before his death, Bohr was questioned by Thomas Kuhn about the nature of his interest in fundamental philosophical problems. His answer was direct: 'It was in some ways my life you see.'" (Folse 31) That reply has an understatement and sadness to it that left me quiet for a long time.

## The Metaphysics of Quality

I want to make a sharp shift now from Copenhagen to the town of Bozeman, Montana and the English department of Montana State College in 1959 when I was a teacher there. Sometimes people come at me when I talk about quality as though I had made the whole problem up by myself. But I was under legal contract with the state government of Montana to teach quality even though I had no clear idea what it was, and nobody else did either. Anthropologists know that every culture has strange and bizarre practices that make no sense from a practical view, but it is much easier to spot those practices in other cultures than in our own. I will point out to you that for centuries rhetoric instructors in our culture have been paid to pass and fail students on the quality of their writing without ever having any viable definition of what that quality is or even if there is such a thing at all. This is a bizarre practice that I tried to end.

In *Zen and the Art of Motorcycle Maintenance* I described how the question, "What is quality?" had been arrived at, and I described the first attempt to solve it where Phaedrus thinks to himself: "Quality ... you know what it is, yet you don't know what it is. But that's self-contradictory. But some things are better than others, that is, they have more quality. But when you try to say what the quality is, apart from the things that have it, it all goes pof! There's nothing more to talk about. But if you can't say what Quality is, how do you know what it is, or how do you know that it even exists? If no one knows what it is, then for all practical purposes it doesn't exist at all. But for all practical purposes it really does exist. What else are the grades based on? Why else would people pay fortunes for some things and throw others in the trash pile? Obviously some things are better than others ... but what's the 'betterness'? ... So round and round you go spinning mental wheels and nowhere finding anyplace to get traction."

It was a common mischievous practice for students to send the same rhetoric paper to different teachers and observe that it got different grades. From this the students would argue that the whole idea of quality was meaningless. But one instructor turned the tables on them and handed a group of papers to several different students and asked each student to grade them for quality. As he expected, the student's relative rankings correlated with each other and with those of the instructor. This meant that although the students were saying there is no such thing as quality, they already knew what it was, and could not deny it.

So what I did is transfer that exercise into the classroom, having the students judge four papers day after day until they saw that they knew what quality is. They never had to say in any conceptual way what kind of object quality is but they understood that when you see it you know it. Quality is real even though it cannot be defined.

Eventually my unusual teaching methods came to the attention of the other professors in the department and in a friendly way they asked the question that connects all this with the struggles of Niels Bohr: "is quality in the subject or in the object?" The answer that was finally given was, "neither, Quality is a separate category of experience that is neither subject or object." This was the beginning of the system of thought called the Metaphysics of Quality. It has lasted for more than 35 years now. The question today is, if Niels Bohr had given that answer would his system of Complementarity have been improved?

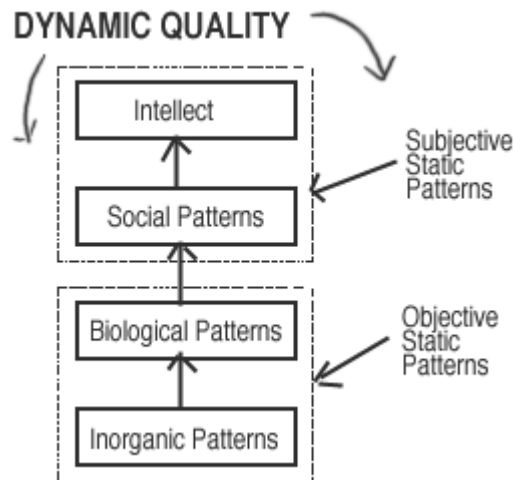
In the Metaphysics of Quality the world is composed of three things: mind, matter and Quality. Because something is not located in the object does not mean that it has to be located in your mind. Quality cannot be independently derived from either mind or matter. But it can be derived from the relationship of mind and matter with each other. Quality occurs at the point at which subject and object meet. Quality is not a thing. It is an event. It is the event at which the subject becomes aware of the object. And because without objects there can be no subject, quality is the event at which awareness of both subjects and objects is made possible. Quality is not just the result of a collision between subject and object. The very existence of subject and object themselves is deduced from the Quality event. The Quality event is the cause of the subjects and objects, which are then mistakenly presumed to be the cause of the Quality!

The most striking similarity between the Metaphysics of Quality and Complementarity is that this Quality event corresponds to what Bohr means by "observation." When the Copenhagen Interpretation "holds that the unmeasured atom is not real, that its attributes are created or realized in the act of measurement," (Herbert xiii) it is saying something very close to the Metaphysics of Quality. The observation creates the reality.

*Zen and the Art of Motorcycle Maintenance* left one enormous metaphysical problem unanswered that became the central driving reason for the expansion of the Metaphysics of Quality into a second book called *Lila*. This problem was: if Quality is a constant, why does it seem so variable? Why do people have different opinions about it? The answer became: The quality that was referred to in *Zen and the Art of Motorcycle Maintenance* can be subdivided into Dynamic Quality and static quality. Dynamic Quality is a stream of quality events going on and on forever, always at the cutting edge of the present. But in the wake of this cutting edge are static patterns of value. These are memories, customs and patterns of nature. The reason there is a difference between individual evaluations of quality is that although Dynamic Quality is a constant, these static patterns are different for everyone because each person has a

different static pattern of life history. Both the Dynamic Quality and the static patterns influence his final judgment. That is why there is some uniformity among individual value judgments but not complete uniformity.

Here is a drawing of the basic framework of the Metaphysics of Quality:



In this diagram you will notice that Dynamic Quality is not shown in any block. It is in the background. This seems the best way to represent it. It is not only outside the blocks, it pervades them but it goes on where the blocks leave off.

The blocks are organized in the order of evolution, with each higher block more recent and more Dynamic than the lower ones. The block at the top contains such static intellectual patterns as theology, science, philosophy, mathematics. The placement of the intellect in this position makes it superior to society, biology and inorganic patterns but still inferior to Dynamic Quality. The Metaphysics of Quality says there can be many competing truths and it is value that decides among them. This is the very essence of William James' philosophy of Pragmatism which Bohr greatly admired. The name "Complementarity" itself means there can be multiple truths.

The social patterns in the next box down include such institutions as family, church and government. They are the patterns of culture that the anthropologist and sociologist study.

In the third box are the biological patterns: senses of touch, sight, hearing, smell and taste. The Metaphysics of Quality follows the empirical tradition here in saying that the senses are the starting point of reality, but — all importantly — it includes a sense of value. Values are phenomena. To ignore them is to misread the world. It says this sense of value, of liking or disliking, is a primary sense that is a kind of gatekeeper for everything else an infant learns. At birth this sense of value is extremely Dynamic but as the infant grows up this sense of value becomes more and more influenced by accumulated static patterns. In the past this biological sense of value has been called the "subjective" because there values cannot be located in an external physical object. But quantum theory has destroyed the idea that only properties located in external physical objects have reality.

The bottom box shows inorganic patterns. The Metaphysics of Quality says objects are composed of "substance" but it says that this substance can be defined more precisely as "stable inorganic patterns of value." This added definition makes substance sound more ephemeral than previously but it is not. The objects look and smell and feel the same either way. The Metaphysics of Quality agrees with scientific realism that these inorganic patterns are completely real, and there is no reason that box shouldn't be there, but it says that this reality is ultimately a deduction made in the first months of an infant's life and supported by the culture in which the infant grows up. I have noticed that Einstein in his 1936 essay Physics and Reality also held this view. (Jammer 230) Bohr is sometimes mistakenly thought to say that this inorganic level does not exist. However both Folse and Max Jammer argue at length that this is not true. He does not deny this inorganic reality. He simply says that the properties the physicist describes cannot be said to reside at this level.

I can now say some general things about this diagram:

## Values

First, each higher pattern grows out of the lower one so we tend to think of the higher pattern as the property of the lower one. However if you study the world you will observe that the higher patterns often oppose the lower ones. Biological values of life oppose physical values of gravitation and entropy. Social values of family and law and order

oppose biological values of lust and greed. Intellectual values of truth and freedom of opinion often oppose social patterns of government. This opposition of levels of static patterns offers a good explanation of why science in the past has rejected what it has called "values." The "values" it has rejected are static social prejudices and static biological emotions. When social patterns such as religion are mixed in with the scientific method, and when biological emotions are mixed in with the scientific method these "values" are properly considered a source of corruption of the scientific method. Science, it is said should be "value free", and if these were the only kind of values the statement would be true.

However, the Metaphysics of Quality observe that these two kinds of values are lower on the evolutionary ladder than the intellectual pattern of science. Science rejects them to set free its own higher intellectual pattern. The Metaphysics of Quality calls this a correct moral judgment by science. However science never rejects the value of truth. It never rejects the value of experiment. It never rejects the value of mathematical precision. Most important, it never rejects Dynamic Quality. The greatest strength of the scientific method is that it always allows new experiences, new ideas and a new evaluation of what it learns.

Next, notice that the Metaphysics of Quality provides a larger framework in which to integrate subjectivity and objectivity. Subjectivity and objectivity are not separate universes that have no connection to each other. They are instead separate stages of a single evolutionary process called value. I can find no place where the words subjective and objective are used where they cannot be replaced by one of these four categories. When we get rid of the words "subjective" and "objective" completely often there is a great increase in the clarity of what is said. One person who I'm sure would agree with me on this would be Niels Bohr.

A third piece of evidence that reveals the similarity between the Metaphysics of Quality and Complementarity occurs when Bohr says, "We are suspended in language," the Metaphysics of Quality completely agrees. In the block diagram of the Metaphysics of Quality we see that each higher level of evolution rests on and is supported by the next lower level of evolution and cannot do without it. There is no intellect that can independently reach and make contact with inorganic patterns. It must go through both society and biology to reach them. In the past science has insisted on the necessity of biological proofs, that is, proofs in terms of sense data, and it has tried to discard social patterns as a source of scientific knowledge. When Bohr says we are suspended in language I think he means you cannot get rid of the social contexts either. That was his argument to Heisenberg. The Metaphysics of Quality supports it.

The fourth evidence of similarity is that the Metaphysics of Quality substitutes the word "value" for cause. It says that to say "A causes B" can be better said as "B values precondition A." This has seemed to me to be a better terminology for describing quantum phenomena. The term "cause" implies an absolute certainty that quantum theory says does not exist.

The fifth evidence of similarity is that probability itself may be expressed as value, so that "a static pattern of inorganic values," which is a definition the Metaphysics of Quality gives to "substance," is the same as "a pattern of probabilities," which is a definition quantum theory gives to substance. If the atomic world is composed of probability waves and if probability is equal to value then it follows logically that the atomic world is composed of value. The literature on probability is very large and I haven't read it but I have noted that Heisenberg has said that "the possibility or 'tendency' for an even to take place has a kind of reality — a certain intermediate layer of reality, halfway between the massive reality of matter and the intellectual reality of the idea or the image ... it is formulated quantitatively as probability and subject to mathematically expressible laws of nature." (Qtd in Jammer 44) This intermediate reality Heisenberg talked about may correspond to value, but I'm not sure of that. Although probability may equal inorganic value it certainly doesn't equal any of the other value patterns. All of these patterns — all of life — seem to be in a war against it. In biology, conformity to inorganic probability is another name for death.

### **The Conceptually Unknown**

The sixth piece of evidence is that the Metaphysics of Quality answers a problem that Bohr refused to answer. His refusal has weighed against him. Bohr "refused to comment on the relationship between Complementarity and the nature of physical reality." (Folse 223) "Bohr never makes clear in what sense we can have knowledge of the reality which causes our experiences." (Folse 241) He leaves it just hanging in limbo.

The question is why would Bohr do that? It is absurd to think that he forgot about it, that it just slipped his mind. He must have had a reason. The explanation, I think, is that Bohr is prohibited from speaking about any external physical reality ahead of the experiment. Before the experiment he must say there is nothing to know. In the old classic physics an external object was put into the front end of the experiment. It was subject to one or another forces and the results studied. Now that external object is gone. Whatever Bohr says about anything that goes into the front end of the experiment will be taken as a property of an independent physical reality. It is vital to Complementarity that there are no properties until after the observation.

So Bohr never mentions the unmeasured phenomenal object shown as the larger dashed oval in the diagram of Complementarity. But as was said before, something has to be there. If it were not there the measuring instruments would just be measuring their own internal characteristics. It is clear from what Bohr does say that the unmeasured phenomenal object is unpatterned. The patterns only emerge after an experiment. This unmeasured phenomenal object is not the subject of classical physics. So what is left to conclude? It seems to me that it is not a very large jump of the imagination to see that this unmeasured phenomenal object is in fact a third category, which is not subject and not object because it is independent of the two. When this assertion is made Complementarity is out from under its lifelong accusation of subjectivity. We no longer need to claim that we ourselves alter scientific reality when we look at it and know about it — a claim that Einstein regarded as part of a "shaky game."

The similarity between Dynamic Quality and Bohr's unmeasured phenomenal object does not at first seem very great. It is only when one sees that the unmeasured phenomenal object is not really phenomenal and not really an object that the two draw closer together. The unmeasured phenomenal object is not really phenomenal because it has no characteristics before an observation takes place. It is not really an object because objects are over in that right oval with the question mark in it. Those objects are what are being rejected in the first place. So what is this unmeasured phenomenal object?

It seems to me that a keystone in a bridge between the Metaphysics of Quality and Complementarity may be established if what has been called the "unmeasured phenomenal object" is now called the "The Conceptually Unknown" and what is called "Dynamic Quality" is also called "The Conceptually Unknown." Then the two come together. I would guess that the Conceptually Unknown is an unacceptable category in physics because it is intellectually meaningless and physics is only concerned with what is intellectually meaningful. That also might be why Bohr never mentioned it. However I think that this avoidance of The Conceptually Unknown should be revised. It is like saying that the number zero is unacceptable to mathematics because there's nothing there. Mathematics has done very well with the number "zero" despite that fact. The Conceptually Unknown, it seems to me is a workable intellectual category for the description of nature and it ought to be worked more. As a starting axiom I would say, "Things which are intellectually meaningless can nevertheless have value." I don't know of an artist who would disagree with that. Certainly not Rene Magritte.

For those who would like more information about this "Conceptually Unknown" than I can give them today there is a valuable book called *Zen in the Art of Archery* by Eugen Herrigel from which I derived the title for my own first book. When the Zen Archer refers to an "it" that shoots the arrow he is referring to what I mean by Dynamic Quality. For those who prefer to stay more within the confines of Western analytical thought there is a book by Prof. F.S.C Northrop of Yale University called *The Meeting of East and West*. It is the book that really started me on this philosophic quest that has now lasted 47 years.

Northrop's name for Dynamic Quality is "the undifferentiated aesthetic continuum." By "continuum" he means that it goes on and on forever. By "undifferentiated" he means that it is without conceptual distinctions. And by "aesthetic" he means that it has quality.

I think that science generally agrees that there is something that has to enter into experiments other than the measuring instruments, and I think science would agree that "Conceptually Unknown" is an acceptable name for it. What science might not agree on is that this Conceptually unknown is aesthetic. But if the Conceptually Unknown were not aesthetic why should the scientific community be so attracted to it? If you think about it you will see that science would lose all meaning without this attraction to the unknown. A good word for the attraction is "curiosity." Without this curiosity there would never have been any science. Try to imagine a scientist who has no curiosity whatsoever and estimate what his output will be.

This aesthetic nature of the Conceptually Unknown is a point of connection between the sciences and the arts. What relates science to the arts is that science explore the Conceptually Unknown in order to develop a theory that will cover measurable patterns emerging from the unknown. The arts explore the Conceptually Unknown in other ways to create patterns such as music, literature, painting, that reveal the Dynamic Quality that produced them. This description, I think, is the rational connection between science and the arts.

In *Zen and the Art of Motorcycle Maintenance* art was defined as high quality endeavor. I have never found a need to add anything to that definition. But one of the reasons I have spent so much time in this paper describing the personal relationship of Werner Heisenberg and Niels Bohr in the development of quantum theory is that although the world views science as a sort of plodding, logical methodical advancement of knowledge, what I saw here were two artists in the throes of creative discovery. They were at the cutting edge of knowledge plunging into the unknown trying to bring something out of that unknown into a static form that would be of value to everyone. As Bohr might have loved to observe, science and art are just two different complementary ways of looking at the same thing. In the largest sense it is really unnecessary to create a meeting of the arts and sciences because in actual practice, at the most immediate level they have never really been separated. They have always been different aspects of the same human purpose.