THE BLIND SPOT

Science and the Crisis of Uncertainty

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Contents

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Preface: The Revelation of Uncertainty

We are going to have to learn to live with a lot
more uncertainty for a lot longer than our
generation has ever experienced.
—Thomas L. Friedman[1]

This book is about science, what it is as opposed to what people say it is; what scientists do as opposed to what most people believe they do. Science is what we use to understand the world and to understand ourselves. It defines what is real and sets limits on what is possible, on what is conceivable. Today when the dream of unending and inevitable progress seems unduly optimistic, then perhaps the time is ripe to go back and reexamine our view of science and sort out its strengths from its weaknesses.

Most people would identify science with certainty. Certainty, they feel, is a state of affairs with no downside, so the most desirable situation would be one of absolute certainty. Scientific results and theories seem to promise such certainty. The popular belief in scientific certainty has two aspects: first, that a state of objective certainty exists and second, that scientific kinds of activities are the methods through which this state can be accessed. Yet I will make the case that absolute certainty is illusory and that the human need for certainty has often been abused with noxious consequences.

Contemporary society is beset by an ever-increasing set of crises and potential crises, which are exacerbated, and in some cases brought on, by a misreading of science and the scientific method, a misreading that we could call pseudo-science. This brings on a kind of vicious circle where the solutions that are proposed to the problems we face only succeed in making matters worse. Is there another, expanded, way of looking at science that will put the drive for certainty in perspective and provide a

framework within which uncertainty can be seen as both inevitable and as an opportunity? That is the challenge of this book.

Many people have the naïve belief that every problem can be solved by science and technology, through the systematic application of certain practices and ways of thinking. Unfortunately, the leaders of government, commerce, and industry are among those who tend to hold these views. At the other extreme there are those religious fundamentalists who blame many of the ills of civilization on science and fantasize about some pre-scientific paradise. Both of these views elevate science and technology to the center of modern culture. In this respect, at least, both views agree and are correct. Science, both directly and through its influences, is the dominant element in modern civilization.

Yet modern civilization is in crisis! We face not just one crisis but a series of interconnected crises—the economic crisis, the environmental crisis, and the crisis in relations between the secular and religious worlds, especially the world of religious fundamentalism. There is a deep connection between these crises and the world of science and technology. In fact, a better way to think about the present situation is that what looks like a series of disparate crises is really one crisis that manifests itself in various ways—one all-encompassing crisis that arises from inner contradictions that are inherent in modern culture. The origin of this fundamental crisis is to be found in a misunderstanding of the nature of science. Unfortunately, such a misunderstanding is also quite common in those highly educated segments of society that are called upon to respond to the critical situation we face. One's response to any problem is constrained by one's understanding of it and so it is with our contemporary difficulties.

This book will demonstrate that our understanding of science is simplistic and thus inadequate to the task at hand. We must develop a more sophisticated understanding of what science is, and, as a consequence, what it can and cannot do for us. Most of us assume that science is monolithic—science is science is science—but this book will demonstrate that science carries within it diverse tendencies. To highlight these differences I give them different labels—the "science of certainty" versus the "science of wonder" but we should take the former to be a simplistic misinterpretation of the latter. What differentiates these two viewpoints is whether or not what I shall call the Blind Spot is acknowledged. The

Blind Spot refers to an intrinsic and inevitable limitation to scientific theories and even to scientific concepts.

All of the crises mentioned here can be traced back, in one way or another, to the point of view of the science of certainty. What Friedman said earlier about the economic situation seems to be generally true of our times—as societies and as individuals, we must learn to live with uncertainty. The two approaches to science that I discuss in this book divide up neatly in this regard; the first attempts to deny or eliminate uncertainty, the second takes uncertainty as an inevitable fact of life, as an opportunity, and considers how best to work with it.

Science and technology have come to define what is real, to define what is true. It is a well-worn cliché to say that in order to look for creative solutions to the problems we face, we must learn to "think outside the box." A certain ideology of science and technology constitutes the proverbial "box" in this instance, and we must get outside of it if we hope to deal with the present situation.

I emphasize that I am not condemning science and technology as a whole, nor am I ignorant of the many benefits that science has conferred upon the world. The problem lies not with science but with the point of view that I call the "science of certainty," a particular approach to science in which the need for certainty, power, and control are dominant. The identification of all of science with this particular tendency within science makes up a kind of "mythology of science." It is this mythology that is called upon when some governments, administrators, and businessmen misuse science to justify their questionable practices. This attitude has caused of a great deal of damage. It must be brought to consciousness if it is to be questioned and changed. It follows that in our search for what has gone wrong and what can be done to fix it, we must take another look at science.

It seems strange to call science a mythology since the story that science tells about itself is precisely that it is objective and empirical; that it concerns itself with the facts and nothing but the facts. This is often what we are referring to when we use the word "scientific." And yet science is a human activity, an activity pursued by human beings. This is an obvious statement but it bears repeating since part of the mythology of science is precisely that it is independent of human beings, independent of mind and intelligence. If these claims were correct then they would

point to a mystery that is not always appreciated. How do human beings create a system of thought that produces results that are independent of human thought? For science certainly involves a particular way of using the mind. Most often we think of scientific thinking as rational thinking characterized by clarity and logic. Are these the only characteristics of scientific thinking? Are they even the most important ways in which scientists think? Can such thinking conceivably produce the grand creative leaps that science is famous for? Can such thinking help us escape from the "box" in which we find ourselves?

I mentioned that in these early years of the twenty-first century the dominant cultural force, for good and for bad, is science, and a certain way of using the mind that passes for systematic thought. Of course, the ways in which we think impose limits on the possibilities for change. We have a very restricted notion of how open-ended the situation is and so we feel that our possibilities are limited. We feel constricted by the scope of the problems we face and so we have almost lost hope.

But are the current problems that society faces really different in kind from the situation that every person who does creative work finds himself or herself in on a regular basis? Authentic scientific workers live in a world of change that brings with it the need to continually rethink the significance of what they are doing and why they are doing it. Science is an exercise in human creativity. As such, it must continually reach toward the unknown and the uncertain, toward the Blind Spot. It must look back to its mysterious and opaque sources in the human mind. We must learn to allow these creative sources to form part of the language we use when science is discussed and applied. We must find a new way to talk and think about science because the point of view that underlies most of our discussions is not only incomplete and therefore incorrect, it is dangerous!

The book is organized in the following way. Chapter 1 introduces the existence of an inevitable "blind spot" in our scientific theories, an unavoidable incompleteness in our description of reality. This blind spot arises out of human consciousness itself, and is rooted in the biology of the brain. In chapter 2, I discuss how specific breakthroughs in science and mathematics have revealed this blind spot. Modern scientific thought is permeated with the discovery of the uncertain in various guises. There are two possible reactions to these kinds of discoveries—one negative

and one positive. The negative response involves anxiety and repression; the positive is connected to creativity.

Chapter 3 isolates and compares two different aspects of science that I called the science of certainty and the science of wonder. These contrast the need for certainty and rigor with the need for freedom and creativity. Science contains both of these tendencies, but they do not coexist comfortably—the two conflict. In chapter 4, this dichotomy within science is linked to some of the crises that the world is currently experiencing in the economic and political spheres.

I then go on to show how mathematics and science contain elements of the uncertain. Ambiguity can be thought of as a form of uncertainty, so chapter 5 introduces this central notion as a single idea that can be seen from conflicting points of view. Ambiguity is seen to be unexpectedly present in much of mathematics and science. In chapter 6, another kind of ambiguity is discussed, this time in the fact that the scientist is inevitably both participant and observer in his scientific work. This introduces the element of self-reference, observing oneself as a participant, which is central to my description of scientific activity.

Chapters 7 through 9 take up the task of finding a way to talk about a scientific world replete with uncertainty and self-reference. Chapter 7 begins a discussion of scientific concepts by considering the notion of number. Actually, it is claimed that "number" is not a concept but a proto-concept, by which I mean an idea that generates concepts. Number is seen to involve the related ideas of quantity and measurement but number also has qualitative properties that are usually not mentioned in a discussion of science. The distinction between quality and quantity lets us look at the whole scientific enterprise from an unusual perspective.

Much of the previous discussion has brought to the fore conflicting perspectives that are present in science and in the scientist. Chapter 8 sees these conflicts from the perspective of a deeper unity that forms the essential context for any deep discussion of science. Science is motivated by a desire to unify our experience of the world and to unify our selves with the world. Yet this unity that is discussed is a subtle affair; it is a divided unity. It is this division within unity that generates the complexity we find in our description of the natural world.

In chapter 9, I demonstrate that it is the self-referential element within science that generates its dynamism. Science that is alive and growing is

a science that has a complex, fractal nature. This complexity has its roots in a description of reality in which ambiguity is fundamental and objective clarity is but one aspect of a deeper ambiguity. Finally, in chapter 10, I consider the lessons that this view of science can teach us, and how it might affect our approach to the series of crises that began the book.

THE BLIND SPOT

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1

The Blind Spot

There are, indeed, things that cannot be put into words.
They make themselves manifest.
—Ludwig Wittgenstein[1]

Ludwig Wittgenstein was one of the great philosophers of our time, and yet the preceding statement is among his more obscure, especially when thought of in relation to science. In this case, he is saying that certain aspects of science, though real, cannot be put into words. Einstein understood this very well when he talked about his feeling that "behind anything that can be experienced there is something that the mind cannot grasp and whose beauty and sublimity reaches us only indirectly and as a feeble reflection."[2] The "blind spot" is my name for those things that are real but which the mind cannot grasp and thus cannot capture through words, symbols, or equations. I will now give some inkling of what Wittgenstein and Einstein were talking about, even though trying to use words to indicate that there is something beyond words is obviously a strange, not to say paradoxical, thing to do.

Let me begin with an old joke. A drunken man has lost his house keys and is searching for them under a streetlight. A policeman approaches and asks what he is doing.

"Looking for my keys," he says. "I lost them over there." And he points down the street.

"So why are you looking for them here?"

"Because the light here is so much better," the man replies.

The "light" refers to language, concepts, and reason. There is, for example the expression "the light of reason." "Darkness" would then rep-

resent the reality that lies behind conceptual language, reality in its pristine form—precisely what science is attempting to investigate. When you think about it, this is a little strange. We are trying to describe the darkness, but we do it by turning on the light. Of course, when you turn on the light, the darkness inevitably disappears. Darkness is a metaphor for the blind spot and, for this reason, the blind spot does not refer to some particular fact that cannot be put into words or some specific situation that cannot be understood. The blind spot is implicit in every situation.

Think about young children before they have learned to talk. I have a granddaughter, Aviva, who has just turned one. She is a delight—so interested in exploring her environment, so excited by her new experiences, the new textures to touch, new tastes, and so on. The world for her is a world of wonder! The blind spot refers to this world of wonder. Of course, as Aviva grows up, the immediacy of the sensory world will recede as she acquires verbal and intellectual skills, but it will never disappear. It will always be there, ready to reveal itself to her in one of those magical moments that occur from time to time in everyone's life.

I have borrowed the expression "blind spot" from the psychological phenomenon of the "blind spot" in our visual field. The *physiological blind spot* is the place in the visual field that corresponds to the lack of light-detecting photoreceptor cells on the optic disc of the retina where the optic nerve passes through it. Since there are no cells to detect light on the optic disc, a part of the field of vision is not perceived. The brain fills in with surrounding detail and with information from the other eye, so the blind spot is not normally perceived.[3] It seems incredible that our visual perception is incomplete in this way; it goes against our inner conviction that the world we perceive is coherent and complete. But the existence of the visual blind spot is a good metaphor for the ungraspable element that we confront when we attempt to probe the natural world in our scientific work. Just as our brain provides us with the illusion that there is no visual blind spot, so our rational intelligence—through its insistence on consistency and completeness—hides the blind spot from our consciousness.

Another scientific metaphor for the blind spot is the phenomenon of the black hole, a "region of space-time from which nothing, not even light, can escape. A typical black hole is the result of the gravitational force becoming so strong that one would have to travel faster than light to escape its pull."[4] Because black holes exist but cannot be seen, they are

a good way to think about the blind spot. Black holes contain singularities at their centers, points at which the equations of general relativity break down. These singularities are mysterious objects. Are they real or do they merely indicate a breakdown in a particular theory? Any physical theory that attempts to put together quantum mechanics and relativity will have to deal with the phenomena of black holes and singularities. I would argue that the relationship of black holes to a fundamental physical description of the world is analogous to the relationship of the blind spot to a fundamental philosophical description of science.

The experience of suddenly becoming aware of what was formerly a blind spot is shocking and disturbing. Consider the experience of the blind spot in your car. You decide to change lanes and so check your rearview mirror to make sure you have plenty of room to merge into the oncoming traffic. However, just as you start your move, a car you were not aware of, pops up, seemingly from nowhere. This is an experience every driver has had. It is disconcerting and a little embarrassing. Why? Because we realize with a shock that the mental picture we had of the cars on the highway is not identical to the actual situation. It takes a while to settle down again and regain confidence in the accuracy of our mental map.

The preceding metaphors and analogies have something to teach us about our scientific descriptions of the natural world. All such descriptions have inevitable spots that we are blind to precisely because it is the function of language and culture to hide them. Consider something that Stuart Kauffman, the theoretical biologist and complex systems researcher, said,

> My claim is not simply that we lack sufficient knowledge or wisdom to predict the future evolution of the biosphere, economy, or human culture. It is that these things are *inherently* beyond prediction. Not even the most powerful computer imaginable can make a compact description in advance of the regularities of these processes. There is no such description beforehand. Thus the very concept of a natural law is inadequate for much of reality.[5]

The statements of Wittgenstein and Kauffman contain the seeds of a different view of science, one that admits that there exists an intrinsic limitation to what can be known through science. It places science within a more open and spacious context and sets the stage for this chapter.

The existence of that which is real but cannot be understood poses a major challenge to our usual way of thinking about the world and to our thinking about the relationship between human beings and the natural world. Ask yourself if you believe that there are things that cannot, in principle, be understood. Your answer will tell you a great deal about yourself! The discovery of such "limits to reason" is in many ways the key scientific discovery of the twentieth century, one that our society has still not fully assimilated. I shall go into specifics in the next chapter but for now let me just say that it is this factor that explains the controversial nature of a good deal of modern mathematics and physics. I am thinking about Cantor's discovery of different orders of infinity; Gödel's proof that within any deductive system there are results that are true but cannot be proved; about the second law of thermodynamics that states the amount of disorder within a system must always increase; about uncertainty and complementarity in quantum mechanics; about the "butterfly effect" in the theory of chaotic systems, which says that every small change in the initial conditions of a system can have an enormous effect on its eventual state; and about randomness that seems to show up just about everywhere, from the theory of evolution to the fluctuations of the stock market. All of these point to intrinsic limitations in our ability to pin down reality in concepts and symbols. This is a key ingredient in the approach to science and mathematics that I am taking in this book, an approach that attempts to come to grips with the element of self-reference that is inevitably part of any attempt to describe the world as a living system.

ON DEFINITION

I think that there is such a thing as Quality, but as soon as you try to define it, something goes haywire. You can't do it.
—Robert Pirsig[6]

What is a definition? In science, we usually think that a concept is captured by means of a definition. It makes the concept precise; it circumscribes the concept; it sets limits so we can now say precisely what is and what is not an instance of the concept. Such precision through definition

is a necessary condition for a subject to be regarded as scientific. Without this kind of precision it would be difficult to imagine the process of measurement and quantification getting started. If I ask what a (mathematical) group is, the answer is a set whose elements can be multiplied in some reasonable way subject to some very specific requirements. The concept *is* its definition. Yet, as we shall see, many mathematical and scientific concepts point to something that is deeper, more all encompassing, than their definitions. Some things cannot be put into words because doing so is only an approximation to the real situation. The verbal or symbolic formulation captures some aspects of the situation but is not identical to it. There is a question regarding the relationship between the definition and the thing being defined.

To really grasp the essence of the problem with definition, one must go back to the Ancient Greeks. The Greek philosopher Parmenides is reputed to have maintained that you can only speak of what is, "what is not cannot be thought of and what cannot be thought of cannot be." It followed from this attitude that (absolute) "infinity" or even "zero" could not be defined because they "could not be." This attitude is a philosophical precursor to the "naïve realism" of today: the sense that the proper role of language is to enter into a one-to-one correspondence with the objects of the real world. It is a sensible reaction to the complexities of language. At first glance, it seems entirely reasonable to insist on a one-to-one correspondence between words and reality. Why? Because it protects us from the self-referential spiral that is inherent in human self-consciousness, the ambiguity that lies at the heart of the human condition that I shall discuss in subsequent chapters.

The problem of the relationship between language and reality is a problem that has been around for a long time. It is a vital problem, since without a clear notion of the nature of "definition" we cannot really begin to study mathematics or science. This question is a primordial one for any philosophy of science.

Is it always possible to keep the definition of a concept consistent with its meaning? Think about "zero." Zero represents "nothing," yet "zero" is not nothing—it is a digit, a number we use every day. The definition of "zero" is inconsistent with the meaning of zero. We can see why the Greeks could not entertain the idea of "zero," yet their math and science was the poorer for this omission.

Even ordinary mathematical ideas share, to a certain extent, this problem with definition and, as a result, we shall have to learn to think about definitions in a new way. Take, for example, the idea of "number." What is a number? It is scarcely possible to define "number"—it is so basic and elementary. The German mathematician, logician, and philosopher, Friedrich Ludwig Gottlob Frege, tried to show that the idea of number could be developed starting with the idea of "set." The idea was to establish a firm foundation for all of mathematics. His attempt ultimately failed because of the discovery of certain paradoxes that arise when one thinks of a set in a naïve way as just a collection of objects. But that is not the main problem with this kind of approach. The problem is that such reductionism causes us to lose touch with the very thing we are interested in understanding—here, the nature of "number," the deepest and most important source of mathematics. The fact that "number" can or cannot be developed from some other concept does not necessarily help us in our attempt to understand and explore "number." In a sense, number cannot be defined, and yet to leave it at that is somehow also dissatisfying. "Number" evokes a whole universe, an entire manner of looking at the world, which I shall discuss in some depth in chapter 7. This universe can only be explored, not captured. Every deep mathematical or scientific idea, like the idea of number,[11] evokes a whole world. Some of these situations have a consensual meaning—integers, rational numbers. Some, like real numbers, are more complicated. But mathematics contains many different kinds of numbers and there is no intrinsic limit to the capacity of mathematicians to produce new kinds of numbers in the future.

Trying to understand something often means trying to give it a definition, yet (as in the case of infinity or randomness) another definition is always possible. Each definition structures a certain field of mathematical or scientific thought. Certainly one definition may be better than another but even an excellent definition does not capture the informal domain out of which it emerges. It structures the informal situation. When we use the word definition, we are usually referring to this formalized version, and yet understanding a given situation necessitates the integration of both levels—the formal and the informal. You could say that it is impossible to understand the informal, but the formal situation also has its difficulties. "Understanding" demands placing something in a

context. It implies having a "feel" for the situation in which the concept arises, not to mention the ability to use the concept in novel situations or solve problems not previously encountered. You cannot understand a definition by parsing it. You acquire an understanding by working with the definition in many different circumstances, by thinking about it, by solving problems involving the concept, and by making mistakes and learning from those mistakes. Understanding is a process without end. At a certain stage in the process, one can say, "I understand randomness." But in reality you can always understand it better, understand it differently. The better you understand it, the more grounded you are in the primal notion. Randomness is not a thing. In a way, it does not exist; it is open and inevitably incomplete. Yet every formal definition of randomness produces its own reality that needs to be understood.

All interesting and important concepts have definitions with this kind of depth. An explicit formulation is not *the* definition but should be thought of as an "entry point," the beginning of an exploration. We then work with this (tentative) definition trying to expand our understanding. We do this by exploring in two directions simultaneously—backward by evoking the informal situation out of which it arose, forward by exploring examples and consequences. In the process of this exploration, our understanding will be expanded and made subtler. This process may then be iterated a number of times. Each subject we explore should be thought of more as a "field" (like an energy field in physics) than a fixed and definite object. A field does not have a fixed objective meaning. It is much much larger than that.

THE UNGRASPABLE

The conclusion of the previous discussion is that, in the deepest and most profound sense, the things that make up the world cannot be defined, nor can they be understood or pinned down in any definitive way. This is the gap that has emerged in the order of things, a gap and a challenge that has the most profound implications for how we conceptualize the entire scientific enterprise. I'll refer to this gap by speaking of the ungraspable.

Science is a way of approaching the world; it consists of asking nature certain kinds of questions and of obtaining certain kinds of responses.

The entire world of science is grounded in human consciousness and rationality. In science, the world is described in a specific way, using a certain kind of language—and so reality is reduced to rationality. How accurate is the picture of reality obtained through science? The existence of the "ungraspable" implies that there are intrinsic limitations to the cultural project of reducing reality to rationality. In a manner that is paradoxical yet consistent with the lessons of scientific progress in the last century, I shall base my critique of science on recent developments in science itself.

Blindsight

The New York Times recently carried an article written by Benedict Carey about a man, T. N., who had been left blind by two successive strokes yet was able to successfully navigate a cluttered hallway full of potential obstacles. Brain scans showed that the patient had no visual activity in the brain's cortex—he was profoundly blind—yet he saw. How was that possible? "Scientists have long known that the brain digests what comes through the eyes using two sets of circuits. Cells in the retina project not only to the visual cortex—the destroyed regions in this man—but also to subcortical areas, which in T. N. were intact." Most people are not aware that they possess these alternative resources for processing visual information. In fact, Beatrice de Gelder, a neuroscientist at Harvard and Tilburg Universities and the researcher involved with this experiment, said, "The more educated people are, in my experience, the less likely they are to believe they have these resources that they are not aware of to avoid obstacles." The patient, a doctor, was dumbfounded that he could navigate the obstacle course.

I bring up this experiment because it has implications for our discussion of the ungraspable. To grasp something usually means to integrate it into our normal conscious rational view of things. The essence of what is going on here is that what has been eradicated is what you could call "conscious sight," the normal sight of the visual cortex. Because the visual cortex was destroyed, it became possible to bring subcortical faculties into conscious awareness and possibly restore some partial visual capacity to T. N. Perhaps we also normally think of science as though it were a function of only a certain part of the brain. We have other facul-

ties that are at play in our interactions with the world but they are not normally accessible to our conscious self and therefore often do not show up on our scientific radar screen.

GUT FEELINGS

The next example comes from some studies in 1997 led by Antoine Bechara and Antonio Damasio as described in the book, *The Mind and the Brain*.[12]

> Volunteers play[ed] a sort of gambling game using four decks of cards and $2,000 in play money. All the cards in the first and second decks brought either a large payoff or a large loss … cards in decks 3 and 4 produced … small risk, small reward. But the decks were stacked: the cards in decks 3 and 4 yielded, on balance, a positive payoff. That is, players who chose from decks 3 and 4 would, over time, come out ahead.… A player who chose from the first two decks more than the second two would lose his (virtual) shirt.
>
> Normal volunteers start the game by sampling from each of the four decks. After playing for a while, they began to generate what are called anticipatory skin conductance responses when they are about to select a card from the losing decks. This skin response occurred even when the player could not verbalize why decks 1 and 2 made him nervous. Patients with damage to the inferior prefrontal cortex, however, played the game differently. They neither generated skin conductance response in anticipation of drawing from the risky decks, nor shied away from these decks.
>
> Bechara and Damasio suggest that, since normal volunteers avoided the bad decks even before they had conceptualized the reason but after their skin response showed anxiety about those decks, something in the brain was acting as a sort of intuition generator. Remarkably, the normal players who were never able to figure out, or at least articulate, why two of the decks were chronic losers still began to avoid them. *Intuition, or gut feeling, turned out to be a more dependable guide than reason.* [italics added] It was also more potent than reason: half the subjects with damage to the

> inferior prefrontal cortex eventually figured out why, in the long run, decks 1 and 2 led to net losses and 3 and 4 to net wins. Even so, amazingly, they kept choosing from the bad decks.

The point of this story is again that people have capacities that they cannot bring into everyday verbal consciousness. Even though we can talk about these "gut-feelings," this does not really mean we are "grasping" the intuitive sense. Bringing intuition into consciousness means translating it into another mode of awareness and so changes the original "gut-feeling" into something totally different. It even involves shifting from one region of the brain to another. In this sense, our "gut-feelings" are ungraspable.[13]

The same phenomenon often occurs to me when I write. I may have read some article or had a discussion and I have a gut feeling that there is something there that is relevant to what I am writing about. At this stage, I'm not sure what the relevance is exactly but I begin to write it down and integrate it into the chapter I am working on. More often than not I eventually get something coherent down on the page. When I reread it, I may say to myself, "Ah! That's what I was trying to say." Yet at the stage of the inarticulate gut feeling, my rational self does not understand what I want to say; what I shall end up saying exists but has not yet been grasped.

"Stunned by What Is but What Cannot Be Put into Words"

Now the previous two sections can be taken in various ways. One could conclude that everything can potentially be integrated into rational consciousness and that this is the definitive mode of being in the world that corresponds to the way things are. That is not what I am saying. My position is that *what* is understood cannot be definitively separated from the mental facilities through which we understand. Grasping some topic or situation refers to a particular way of interacting with it. Inevitably, aspects of the world cannot be grasped in principle. This ungraspable nature of things does not only refer to gut feelings or blindsight. It is also a feature of our normal scientific conceptual universe. The ungraspable refers to a quality of intrinsic incompleteness that is inevitably associated with the conceptual.

previously well-established elements, then it would not be necessary to descend into the unknown. The known must be exhausted before one is forced to confront the unknown. The sources of creativity are by definition unknown, inevitably outside of the present conceptual universe, since the conceptual universe is itself the result of acts of creativity.

The unknown is the matrix out of which creativity is born. The birth of creativity, the dawning of insight, is wonderful but unpredictable. One can work hard but that does not guarantee success. One can prepare for it but one cannot program it nor anticipate when or in what form it will eventually appear. Creativity has its origins neither in the natural world nor in the world of concepts—it involves much more than the mere shuffling of well-defined conceptual categories as a computer would do. Where do new concepts come from? If anything, concepts are the results of acts of creativity and not the other way around.

Clearly, a philosophy of science must begin with what is real. However, science is not identical to reality; science is a description of reality. The basic difference is what I meant by the difference between darkness and light at the beginning of this chapter. What we need to do is investigate the relationship between the description and the reality that stands behind it. The first thing that is necessary is to break the mistaken identification of science with reality. Of course, science is not arbitrary; it has a profound relationship with what it describes. Nevertheless, science is not to be equated with the real. This is a statement that is completely obvious yet bears repeating since it is necessary to differentiate between science and the mythology of science, between what science actually does and the story that is told about it. Just as the brain renders invisible the physiological blind spot and gives the illusion that the visual field is continuous and complete, so the mythology of science has the function of hiding from view the holes in the fields of consciousness and rationality. So, like the child viewing the emperor's new clothes, it is necessary to point out this blind spot.

I attempted to do this by talking about the "ungraspable," but the danger is that one thinks of the ungraspable as something divorced from reality. The "blind spot" I am talking about is an inevitable consequence of our rational consciousness. We are aware of it as a lack, but when we turn our conscious mind to it, it inevitably disappears. Yet we can infer the existence of this domain by making a small shift in the way we look