6 Information-Limited Subrealities

What This Chapter is About, and Not About

Previous chapters have laid out the problem: observations from the first and third-person perspectives disagree about the nature of the mind. The solution to this paradox will become apparent in this chapter. But first, a word of caution: *this chapter is not about consciousness*; *it is about physics*. It is about the way that the universe operates, and how we can observe and understand that operation.

The central topic of this chapter, the Information-Limited Subreality, is an objective and physical phenomenon, something that we can scientifically define and describe the properties of. Its relevance to the mind-body problem will be discussed in upcoming chapters. For now, our task is one of physics, not philosophy or psychology. This is important because we will use the concept of the Information-Limited Subreality to define what consciousness is. Therefore, we must take care not to explain the Information-Limited Subreality in terms of consciousness, thus leading to a circular definition.

The Observer

In the last chapter we introduced Special Relativity, a strange area of physics developed by Albert Einstein in 1905. A key topic in this work is the concept of the *observer*. For instance, in the last chapter we saw that a person on earth will see the universe differently than his twin brother in a speeding spaceship. In short, Einstein showed that how you view the world depends on your *condition*, such as your velocity,

acceleration, and even the gravitational field you are in. For instance, consider a group of scientists on the earth, a single astronaut in route to a distant star, and a sophisticated robotic probe exploring the intense gravitational field of a black hole. Since each of these entities is in a different condition with respect to how they observe the universe, we refer to them as three different "observers." The important point is that being an "observer" refers to your *condition*, not to what you *are*. As in this example, an "observer" may be a group of people, a single individual, or even a nonconscious computer.

For instance, look at how Einstein used the concept of different observers to explain the equivalence of acceleration and gravity, a key part of the General Theory of Relativity:

> "We imagine a large portion of empty space, ... far removed from stars and other appreciable masses, ... let us imagine a spacious chest resembling a room with an observer inside who is equipped with apparatus. Gravitation naturally does not exist for this observer. He must fasten himself with strings to the floor, otherwise the slightest impact against the floor will cause him to rise slowly towards the ceiling.
>
> To the middle of the lid of the chest is fixed externally a hook with rope attached, and now a "being" (what kind of being is immaterial to us) begins pulling at this with a constant force. The chest together with the observer then begins to move "upwards" with a uniform accelerated motion ... But how does the man in the chest regard this process? The acceleration of the chest will be transmitted to him by the reaction of the floor of the chest. He must therefore take up this pressure by means of his legs if he does not wish to be laid out full length on the floor. He is then standing in the chest in exactly the same way as anyone stands in a room of a house on earth. ... and he consequently comes to the conclusion

that the chest is suspended at rest in a gravitational field."

"On the other hand, an observer who is poised freely in space will interpret the condition of things thus: The rope must perforce take part in the accelerated motion of the chest, and it transmits this motion to the body attached to it. The tension of the rope is just large enough to effect the acceleration of the body."

In short, the observer inside of the chest sees a gravitational field, while the observer outside the chest sees acceleration. While there is only a single phenomenon, it can be viewed from two different observational conditions.

Descartes' Evil Genius

The basic idea of the "Information-Limited Subreality" is very old. The first systematic account was provided by René Descartes in 1641 (See Fig. 6-1). Descartes was troubled that philosophy was very subjective and controversial, especially when compared to the certainties of mathematics. Of principal concern was the possibility that we may hold false beliefs, such as being deceived by others, ourselves, or the natural world. For instance, he notes the delusions of the insane:

"...certain persons, devoid of sense, whose cerebella are so troubled and clouded by the violent vapors of black bile, that they constantly assure us that they think they are kings when they are really quite poor, or that they are clothed in purple when they are really without covering, or who imagine that they have an earthenware head or are nothing but pumpkins or are made of glass."

While Descartes dismisses these ramblings of madmen, he has a more difficult time with dreaming, where normal people encounter gross deceptions about their existence. Of this problem he writes:

> "How often has it happened to me that in the night I dreamt that I found myself in this particular place, that I was dressed and seated near the fire, whilst in reality I was lying undressed in bed! ... I see so manifestly that there are no certain indications by which we may clearly distinguish wakefulness from sleep that I am lost in astonishment. And my astonishment is such that it is almost capable of persuading me that I now dream."

This potential for deception prompted Descartes to undertake a philosophical method designed to avoid error at all costs, a search for those things that could be known with absolute certainty. In doing so, Descartes intended to elevate philosophy to the same high stature as mathematics. He does this by considering a worse-case scenario, that an all-powerful being is intentionally trying to deceive him about the nature of his existence. He first considers that this deceiver may be God; however, he soon rejects the idea that a supremely good being would perpetrate this type of deception. This leads him to the idea of an **evil genius**, powerful enough to deceive him as God could, and malicious enough to do so:

> "I shall then suppose, not that God who is supremely good and the fountain of truth, but some evil genius not less powerful than deceitful, has employed his whole energies in deceiving me;..."

The problem now facing Descartes is to determine what things this evil genius could deceive him about, and what things he could not deceive him about. Certainly, an all-powerful deceiver is capable of making us dream, as well as driving us mad. Therefore, anything we can potentially experience in either of these two states is something that we can be deceived about. As Descartes notes, the evil genius could even deceive us about the very nature of our existence:

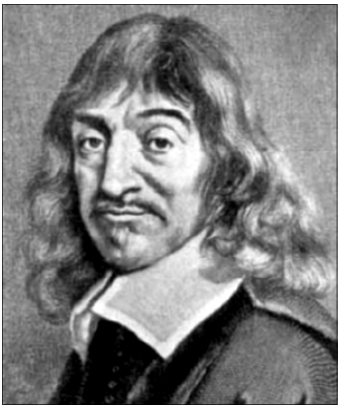

FIGURE 6-1
René Descartes (1596-1650). René Descartes, a French physiologist mathematician and philosopher, is best known for founding analytic geometry, and defining the mind-body problem. The quotes in this chapter are taken from his most influential work, the *Meditations*, first published in Latin in 1641. Descartes was one of the greatest thinkers of the 17th century, and the starting point for all discussions on the nature of consciousness.

> "... I shall consider that the heavens, the earth, colors, figures, sounds, and all external things are nought but the illusions and dreams of which this genius has availed himself in order to lay traps for my credulity; I shall consider myself as having no flesh, no blood, nor any senses, yet falsely believing myself to possess all these things."

Given that the evil genius has such great power of deception, is there anything that we can be sure of, or is everything that we believe under a cloud of doubt? Descartes comes to the logical conclusion that there is something that he could not be fooled about, no matter how powerful the evil genius. And that something is that *his mind exists*. As Descartes reasoned, even an all-powerful being could not fool him into believing that his mind was real, if there were no such thing as his mind. The simple mental act of thinking that you exist is completely sufficient to guarantee that you do exist. As eloquently put in his famous passage:

"I think, therefore I am."

Descartes extended this line of reasoning to identify the basic nature of the mind-body problem. That is, the mind is the thing that thinks and is guaranteed to exist, while the body is a separate thing that we perceive with our senses and we might be deceived about. Further, Descartes had some recognition of how the method of reduction further separates these two things:

> "... we cannot conceive of body excepting in so far as it is divisible, while the mind cannot be conceived of excepting as indivisible. For we are not able to conceive of the half of the mind as we can do of the smallest of all bodies; so that we see that not only are their natures different but even in some respects contrary to one another."

Or as we phrased it more precisely in the last chapter, the third-person view sees the mind as Information, while the first-person perspective sees it as one or more Elements-of-reality.

Descartes' solution to the mind-body problem was *dualism*, that the mortal body is a separate and distinct thing from the immortal soul. He even speculated on the exact site within the brain where the interaction between the physical body and the immaterial mind occurs, the *pineal gland*. This is a small organ located deep within the brain (see Fig. 3-6). It is about the size and shape of a pine nut, after which it is named. Descartes identified this as the seat of consciousness for two reasons, (1) the pineal gland is the only body in the brain that does not have a duplicate in the left and right halves, and (2) it is found only in humans, not animals. Both of these are now known to be incorrect. To this day, some spiritual groups identify the pineal gland as the gateway to the soul. Of course, medical science doesn't hold this view. The pineal gland is known to release the hormone *melatonin* in response to environmental lightness and darkness changes, part of the subject's biological clock.

While questions about the relationship between the mind and body have been around since man began to think, Descartes

was the first to place these issues into a systematic framework. This has made Descartes widely regarded as the father of the mind-body problem. As far as the Inner Light Theory goes, we want to focus on one very specific aspect of Descartes' work: *everything that we perceive might be an illusion, something completely different than the true physical world.*

The Brain in the Vat

In the mid 1900s this same idea reentered philosophy in a scenario known as *The Brain in the Vat.* In the 300 years since Descartes, medical science had learned the basic operation of the brain. In particular, it became known that the brain can only experience what enters its neural inputs, and can only communicate and instigate body motion by means of its neural outputs. This paves the way for Descartes' evil genius, something that no one really believes to exist, to be replaced with something even more terrifying, *technology*.

Imagine the following scenario. One night while you are deep asleep, a scientist enters your bedroom, surgically removes your brain from your body, and carries it back to his laboratory. He plops it into a vat of nutrient solution to keep it alive, and then goes to work attaching electrodes to the ten-million or so neurons that enter and exit your brain. In the morning you wake up and start your daily activities, completely unaware that all of your perceptions now originate from an electronic computer. Everything that you see, hear, feel, touch, and taste is not real; they are nothing but computer algorithms generating the appropriate neural signals into your brain. Even though you believe you are walking, talking, and otherwise moving your body, it is nothing but an illusion. The neural output from your brain is being monitored by the scientist's computer, which then generates the appropriate signals back to your brain. The computer signals make you believe that you "see" the scenery change, "feel" your body parts move, and "hear" the sound of your footsteps. And the most amazing part, you can't tell that

anything has changed in the night; everything seems the same as the day before. This strange story is illustrated in Fig. 6-2.

But what if the scientist doesn't want you living the same life you had? By typing a few commands on his computer keyboard, he can change everything that you perceive. One moment you are sitting at your kitchen table enjoying your morning breakfast, and the next you are an astronaut exploring the surface of a distant planet, or a ballerina dancing across a stage. In the next instant, you have no physical substance at all; you are a disembodied spirit floating effortlessly through the air, able to move yourself and objects around you by mere thought. You are at the scientist's mercy; he can give you pleasures beyond imagination, or pain and horror exceeding your worst fear.

Even stranger, the physical laws in this inner reality are up to the scientist's whims; gravity may cause objects to fall upward, matches may burn before they are struck, and our bodies might be able to move through solid objects. Even more bizarre, this inner reality may be composed of a different dimensional structure, say, four dimensions of distance, two dimensions of time, and one dimension of phase-shift (something that is completely alien and unknown to us). The inner reality does not even need to be consistent; its characteristics might abruptly change for no apparent reason. Indeed, the nature of this inner reality could be virtually anything.

Of course, this is the same scenario that troubled Descartes. The difference is that we now have a detailed understanding of how this strange situation could come about. Descartes' vague "evil genius" has been replaced by physical structures and well-defined operations. This allows us to analyze the phenomenon by using rigorous scientific methods. As mentioned in the introduction, our concern here is physics, not philosophy or psychology.

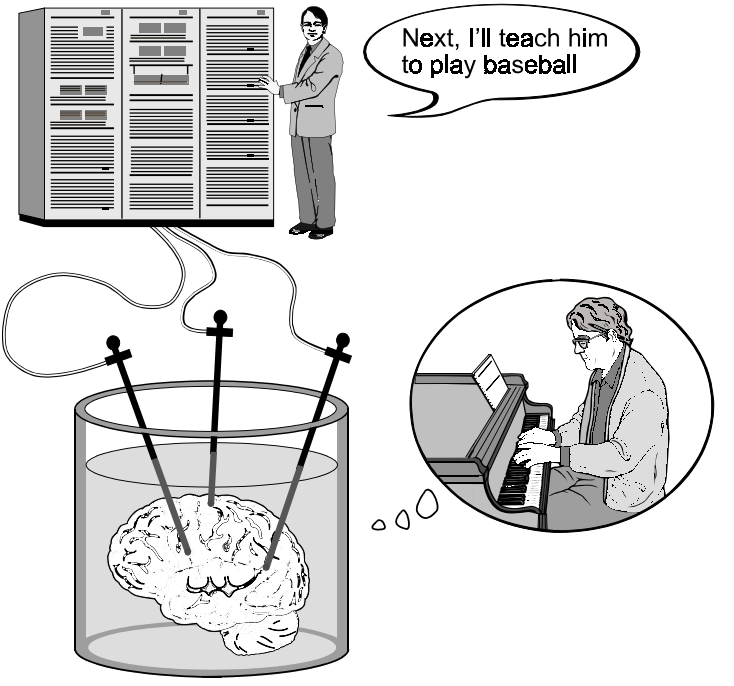

FIGURE 6-2
The Brain in the Vat. The human brain can only interact with the external world by means of neural inputs and outputs. If this neural activity were provided by an advanced computer system, a disembodied brain could experience any conceivable reality.

Since this is a book of science, our starting point must be that the scientific view of our reality is correct. That is, there is a physical universe that exists independently of our minds. It consists of three dimensions of distance, one dimension of time, and obeys consistent physical laws, such as described by biology, chemistry and physics. Our minds arise from the operation of this universe, not the other way around.

While it is *possible* that we are brains in a vat or victims of Descartes' evil genius, there is not the slightest reason for us to

believe that this is *true*. Indeed, giving credence to such ideas is meaningless and counterproductive. For instance, imagine hearing a strange sound as you lie in bed one night. What could it possibly be? The list is endless! It could be a small asteroid destroying the house next door, or a dinosaur eating your tulips. It could be mole-men digging tunnels under your bedroom, or an alien spaceship carrying away your home. Do you give any of these scenarios a second thought? Certainly not; it would be a waste of your time.

While every observer must acknowledge the possibility that their reality is not genuine, they will reject this as a meaningless thought. Our scientific observations tell us that our minds arise from the activity of our brains, and that our brains are but a very small piece of an immense universe. Lacking credible evidence to the contrary, this is the only reasonable thing for us to believe.

But now we want to turn our attention to something that could exist in our universe, a *brain in a vat*. This is something that humans or other intelligent creatures could conceivably construct. It is a physical apparatus, and as such, it can be analyzed in the finest detail, even down to the level of individual atoms. The problem is, if we regard the world on the outside of the vat as the true reality, how are we to understand and classify the reality experienced by this disembodied brain?

First of all, the brain in the vat may or may not know of its true condition. That is, the brain may know that its experiences are being generated by a computer and that nothing in its perceived reality is genuine. For instance, the sadistic scientist may place a video camera over the vat and send the electronic signal into the visual cortex of the captive brain. *"See, you are nothing but a disembodied brain in a vat, and I am your God!*" the scientist might taunt.

On the other hand, the scientist could completely withhold all information about the outside world. Lacking any reason to believe otherwise, the captive brain would believe that its

experiences originate from the external physical universe that it perceives. It would even call its reality the "true reality." While the brain must acknowledge the possibility that it is nothing but a "brain in a vat," it would have no reason to suspect that this is true. In other words, the brain in the vat would understand and perceive its reality in exactly the same way that you and I perceive our reality. But, of course, we would know that it is mistaken. We are in a privileged position to know with certainty that the captive brain's reality is an illusion; it is not a true representation of the external physical universe. This is the situation that we want to understand and explore, and where we will focus our attention.

The Information-Limited Subreality

Using the "brain in the vat" as a guide, our task is to now define the physical phenomenon called an Information-Limited Subreality. Two observers, which we will call the **outer observer** and the **inner observer**, exist in a physical universe. The outer observer has the ability to perceive this universe directly, without distortion or misrepresentation. This means that the reality perceived by the outer observer is genuine; it originates from and represents exactly what it seems to, an external physical universe.

In comparison, the inner observer is in a much more complex condition, being totally *unable* to observe the physical universe. This handicap results from the information accessible to the inner observer being systematically distorted by some process. Moreover, this distortion is not random, but has two key characteristics. First, it blocks all knowledge of the physical universe to the inner observer. Second, the distorted information is completely consistent with *another* physical universe, one that could exist, but doesn't. Of course, the inner observer does not know that what he perceives is an illusion; it is as real to him as real can be. It is the only reality that he knows. But the outer observer can see this situation as it truly

is, a false reality that is generated by manipulating information. For this reason, the outer observer would refer to the experiences of the inner observer as an **Information-Limited Subreality**. Since this is such a long name, we will call it an **inner reality** for short. Likewise, we will refer to the reality experienced by the outer observer as the **outer reality**. Of course, the inner observer would not use any of these terms; to him there is only *reality*.

This definition encompasses Descartes' evil genius, the brain in the vat, and a variety of other important situations. Perhaps the most important way that this definition broadens our understanding is that we are now using the term *observer*. As discussed at the beginning of this chapter, referring to an "observer" is a way of specifying a condition under which observations are made. By definition, who or what is doing the observing is irrelevant; only the nature of what is observed is important. For instance, there is absolutely no requirement for an observer to be conscious. As an example, imagine we built a sophisticated robotic probe, designed to explore the surface of a distant planet with minimal human guidance. We perform a final test by stimulating its sensors with computer generated signals designed to simulate what the probe will encounter on its mission. For instance, the probe might observe that it is in a methane atmosphere, with a temperature of 132 degrees, and total darkness. Of course, this is an illusion; the probe is really in our well-lit and comfortable laboratory. In short, we have placed this nonconscious observer in an Information-Limited Subreality, according to the definitions we have laid out.

Both the inner and outer observers will regard their reality as genuine. While each knows that it is logically possible that they exist in an Information-Limited Subreality, they have no reason to believe this is true. Each will make the claim: *"My reality derives from an external physical universe*." For the outer observer, this statement is true; for the inner observer, it is false. But what is most important, the truth or falsity of this

FIGURE 6-3
Kurt Godel (1906-1978). Godel was an interesting man. He is often regarded as the greatest logician (one who studies logic) to have ever lived. Godel spent time with Albert Einstein and published work on the mathematics of time and time travel. He is also known for his interest in psychic phenomena and his effort to develop a logical proof for the existence of God. Godel starved himself to death at age 72, believing that his doctors were trying to poison him.

statement cannot be proven from within the reality that the statement is made.

This touches on one of the most important mathematical discoveries of the twentieth century. In 1931, the Austrian-American mathematician Kurt Godel shook the foundations of the mathematics world by proving what are now known as the *Godel Incompleteness Theorems.* In nontechnical terms, Godel (Fig. 6-3) showed that within any system of rules there are statements that are true, but cannot be proven to be true within the system of rules. This could not be more disturbing to mathematicians, since mathematics itself is a system of rules. In short, Godel showed that there are mathematical statements that are true, but can never be proven to be true, regardless of how clever mathematicians are or how long they work on them.

As a pertinent example, suppose our inner observer utters the words, *"I exist in an Information-Limited Subreality.*" This is a true statement, but the ability to prove that it is true does not exist within the Information-Limited Subreality. Its truth can only be proven by examining the situation from "outside of the system of rules." That is, by looking at things from the perspective of the outer observer.

The Information-Limited Subreality is a phenomenon that could logically exist in the physical universe as we know it. As such, it is something that we can examine, classify, and determine the properties of. This brings us to *The Inner Light*, a story that allows us to understand the most extraordinary property of the Information-Limited Subreality, the property that is the root of consciousness.

Episode 125: The Inner Light

The *Star Trek* movies and television episodes have become an icon of popular culture. Their contribution has reached far beyond mere entertainment, they have provided unique commentary on social issues and helped to shape our vision of the future. *The Inner Light*, Episode 125 of *Star Trek: The Next Generation*, is one of the most highly acclaimed stories in these collective works, and it holds a special place in our search for the nature of consciousness.

The story begins with the starship *Enterprise* passing through an unknown region of space. Its commander, *Captain Jean-Luc Picard*, stands diligently on the bridge, surrounded by his first officer and bridge crew. The ship's sensors detect an alien probe of unknown design, and they approach it with caution. Without warning, the probe begins to emit a narrow nucleonic beam (a 24th century term) which engulfs the Captain, causing him to fall to the floor. His first officer kneels over him to give care. As Picard looks up from the deck he sees his world change; the face of his first officer fades away and is replaced by that of a young woman, obviously relieved to see him regaining awareness. Picard looks around and finds he is no longer on the bridge of the Enterprise, but in the living area of an unfamiliar residence, wearing unfamiliar clothing. As is common in his century, Picard believes he has been abducted from the Enterprise by a teleportation beam. "What is this place?" Picard demands. The woman seems genuinely confused by the question, as she tenderly responds, "This is your home,

of course." She pleads with him to remain calm, explaining that he has been feverish for over a week. He ignores her advice, and leaves the residence in search of answers.

Picard finds that he is in the small community of *Ressic*, on the planet *Kataan.* The residents know him as their longtime friend *Kamin.* The woman he awoke to is *Eline*, his wife of three years. Those around him dismiss his claims of being a starship captain as delusions of the fever, stealing the memories of his true life. Over the next days, weeks, and years, Picard struggles to find the reason he has been taken from the Enterprise, and to find where in the universe he is being held. But all is in vain; he can find no evidence to support his memories. All that he encounters tells him that he is Kamin, an ironweaver in the community of Ressic, husband to Eline.

Even after five years we find that Picard is still struggling with the memories of his former life. But absent any evidence, and in deference to the wife he has grown to love, Picard puts these memories aside and accepts his new existence. He becomes Kamin, and silences the inner voices that know him as Jean-Luc. Over the next 30 years, Kamin lives a happy life with Eline. He has children and grandchildren, becomes a member of the community's governing council, and spends his days in scientific pursuits and exploring the countryside. He also experiences the human tragedies of life, the death of friends and family, unfulfilled dreams for those he cares about, and struggling against hopeless situations.

In one particularly poignant scene, Kamin tells Eline how realistic his memories still seem, even after many years. He looks at her and the village around him, and softly utters, *"It was real– it was as real as this is."* Now, the viewer knows that this is a very strange statement, since Picard hasn't gone anywhere; he is still laying on the deck of the bridge of the Enterprise. The nucleonic beam is controlling his brain, making him perceive that he is a mere ironweaver from Ressic. Picard's mind is trapped in an Information-Limited Subreality. His

lifetime of experience as Kamin is being played out in only a few minutes, as the Enterprise's medical staff furiously labor to end the attack.

The other details of this story are not important to our investigation of consciousness, so we won't give the away the ending. Suffice it to say that it is haunting and memorable. In 1993, *The Inner Light* won a well-deserved Hugo Award for best dramatic science fiction presentation.

At first glance, one might think that this story adds little to our understanding of Information-Limited Subrealities. Picard trapped as Kamin seems well within the principles laid out by Descartes' evil genius and the brain in the vat. Indeed, when this episode first aired there was no special importance given to it by philosophers or physicists. The reasons that make *The Inner Light* relevant are subtle, yet of great importance.

First, a lesser point, the issue of *believability*. It is easy for us to make the statement: "The brain in the vat experiences a reality just like ours." Further, we can verbally explain why this statement is true and what consequences it has. This is an intellectually sufficient description. However, humans are more than intellectual creatures; we have emotions, attitudes, and knowledge that are difficult or impossible to communicate to others. Learning about the *aurora borealis* in a physics class is one thing, having seen it with your own eyes in quite another. *The Inner Light* allows us to understand the Information-Limited Subreality in a personal way. We empathize with the characters and relate their experiences to those in our own lives. We gain an intimate knowledge that the inner reality is indistinguishable from our own. We come to deeply understand that what happened to Picard could happen to us.

The Principle of Relative Reduction

Now we come to the most important lesson from *The Inner Light*, what will become a central concept in our understanding of consciousness. While Picard is a starship commander, he is

also a trained scientist. Not surprising, he carries his scientific methods and attitudes into his life as Kamin. During his 30 years on Kataan, Kamin engages in a wide variety of scientific research, such as microbiology, astronomy, and climatology, to name just a few. He carries out these activities as he would in his former reality, and the results are just as consistent and well behaved. Kamin has as much ability to be a scientist as Jean-Luc Picard.

The primary tool used by science is the *method of reduction*, which Kamin instinctively uses to understand his reality. Just as in his former life, he finds that everything he observes can be divided into two categories, *Information* and *Elements-of-reality*. While the Information he finds is not especially interesting to us, the Elements-of-reality are critically important. When Kamin examines his world he finds such things as elementary particles, electric and magnetic fields, and the dimensions of time and distance. He observes these things to be irreducible, and therefore by definition, Elements-of-reality. Of course, none of this seems strange or unusual to Kamin; it is the same as he has always known.

But now we must look at this from the perspective of the medical team working to free Picard from the nucleonic beam. They can also use the method of reduction to examine the situation. If they are clever enough, they may even be able to tell what Picard is thinking, feeling, perceiving, and so on. But from their vantage point, they will only observe Information, nothing but the activity in the nucleonic beam and Picard's brain. Everything that Picard observes to be an Element-of-reality, the medical team observes to be pure Information. And the reason for this is simple, the medical team sees the situation as it truly is, while Picard's observations are compromised by the Information-Limited Subreality.

This example leads us to an inescapable conclusion: *the method of reduction is relative*. By this we mean that a phenomenon can appear as *Information* to one observer, but as

an *Element-of-reality* to another observer. Further, each of these observers is fully justified in their belief, having reached their conclusion through the most stringent rules of the scientific method, as well as basic common sense. We must again emphasize that this result does not rely on any of the observers being conscious. This same answer would be found, for example, if the two observers were mindless computers, programmed to observe their environment and classify entities as Information or Elements-of-reality.

We will call this crucial finding the "Principle of Relative Reduction," and it is one of our major teachings:

Major Teaching #3:
The Principle of Relative Reduction

The inner observer of an Information-Limited Sub-reality will perceive Elements-of-Reality, while the outer observer will see these same things as nothing but Information. This is a purely physical phenomenon, something that we can examine and understand in the finest detail.

Now, the applicability of this to the mind-body problem could not be more striking. In the first half of this book we painstakingly showed that the mind-body problem was a paradox; the first-person perspective sees the mind as one or more Elements-of-reality, while from the third-person vantage the mind is pure Information. The Principle of Relative Reduction describes in explicit scientific terms how this could come about. This is the heart of *The Inner Light Theory of Consciousness*.