Perception Packet

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How Do We Know Anything?

If you think about it, the inside of your own mind is the only thing you can be sure of.

Whatever you believe—whether it's about the sun, moon, and stars, the house and neighborhood in which you live, history, science, other people, even the existence of your own body—is based on your experiences and thoughts, feelings and sense impressions. That's all you have to go on directly, whether you see the book in your hands, or feel the floor under your feet, or remember that George Washington was the first president of the United States, or that water is H_2O. Everything else is farther away from you than your inner experiences and thoughts, and reaches you only through them.

Ordinarily you have no doubts about the existence of the floor under your feet, or the tree outside the window, or your own teeth. In fact most of the time you don't even think about the mental states that make you aware of those things: you seem to be aware of them directly. But how do you know they really exist?

If you try to argue that there must be an external physical world, because you wouldn't see buildings, people, or stars unless there were things out there that reflected or shed light into your eyes and caused your visual experiences, the reply is obvious: How do you know *that*? It's just another claim about the external world and your relation to it, and it has to be based on the evidence of your senses. *But you can rely on that specific evidence about how visual experiences are caused only if you can already rely in general on the contents of your mind to tell you about the external world. And that is exactly what has been called into question.* If you try to prove the reliability of your impressions by appealing to your impressions, you're arguing in a circle and won't get anywhere.

Would things seem any different to you if in fact all these things existed *only* in your mind—if everything you took to be the real world outside was just a giant dream or hallucination, from which you will never wake up? If it were like that,

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then of course you *couldn't* wake up, as you can from a dream, because it would mean there was no "real" world to wake up into. So it wouldn't be exactly like a normal dream or hallucination. As we usually think of dreams, they go on in the minds of people who are actually lying in a real bed in a real house, even if in the dream they are running away from a homicidal lawnmower through the streets of Kansas City. We also assume that normal dreams depend on what is happening in the dreamer's brain while he sleeps.

But couldn't all your experiences be like a giant dream with *no* external world outside it? How can you know that isn't what's going on? If all your experience were a dream with *nothing* outside, then any evidence you tried to use to prove to yourself that there was an outside world would just be part of the dream. If you knocked on the table or pinched yourself, you would hear the knock and feel the pinch, but that would be just one more thing going on inside your mind like everything else. It's no use: If you want to find out whether what's inside your mind is any guide to what's outside your mind, you can't depend on how things *seem*—from inside your mind—to give you the answer.

But what else is there to depend on? All your evidence about anything has to come through your mind—whether in the form of perception,

the testimony of books and other people, or memory—and it is entirely consistent with everything you're aware of that *nothing at all* exists except the inside of your mind.

It's even possible that you don't have a body or a brain—since your beliefs about that come only through the evidence of your senses. You've never seen your brain—you just assume that everybody has one—but even if you had seen it, or thought you had, that would have been just another visual experience. Maybe *you*, the subject of experience, are the only thing that exists, and there is no physical world at all—no stars, no earth, no human bodies. Maybe there isn't even any space.

The most radical conclusion to draw from this would be that your mind *is* the only thing that exists. This view is called solipsism. It is a very lonely view, and not too many people have held it. As you can tell from that remark, I don't hold it myself. If I were a solipsist I probably wouldn't be writing this book, since I wouldn't believe there was anybody else to read it. On the other hand, perhaps I would write it to make my inner life more interesting, by including the impression of the appearance of the book in print, of other people reading it and telling me their reactions, and so forth. I might even get the impression of royalties, if I'm lucky.

Perhaps you are a solipsist: in that case you

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will regard this book as a product of your own mind, coming into existence in your experience as you read it. Obviously nothing I can say can prove to you that I really exist, or that the book as a physical object exists.

On the other hand, to conclude that you are the only thing that exists is more than the evidence warrants. You can't *know* on the basis of what's in your mind that there's no world outside it. Perhaps the right conclusion is the more modest one that you don't know anything beyond your impressions and experiences. There may or may not be an external world, and if there is it may or may not be completely different from how it seems to you—there's no way for you to tell. This view is called skepticism about the external world.

An even stronger form of skepticism is possible. Similar arguments seem to show that you don't know anything even about your own past existence and experiences, since all you have to go on are the present contents of your mind, including memory impressions. If you can't be sure that the world outside your mind exists *now*, how can you be sure that you yourself existed *before* now? How do you know you didn't just come into existence a few minutes ago, complete with all your present memories? The only evidence that you couldn't have come into exis-

tence a few minutes ago depends on beliefs about how people and their memories are produced, which rely in turn on beliefs about what has happened in the past. But to rely on those beliefs to prove that you existed in the past would again be to argue in a circle. You would be assuming the reality of the past to prove the reality of the past.

It seems that you are stuck with nothing you can be sure of except the contents of your own mind at the present moment. And it seems that anything you try to do to argue your way out of this predicament will fail, because the argument will have to assume what you are trying to prove—the existence of the external world beyond your mind.

Suppose, for instance, you argue that there must be an external world, because it is incredible that you should be having all these experiences without there being *some* explanation in terms of external causes. The skeptic can make two replies. First, even if there are external causes, how can you tell from the contents of your experience what those causes are like? You've never observed any of them directly. Second, what is the basis of your idea that everything has to have an explanation? It's true that in your normal, nonphilosophical conception of the world, processes like those which go on in

your mind are caused, at least in part, by other things outside them. But you can't assume that this is true if what you're trying to figure out is how you know *anything* about the world outside your mind. And there is no way to prove such a principle just by looking at what's *inside* your mind. However plausible the principle may seem to you, what reason do you have to believe that it applies to the world?

Science won't help us with this problem either, though it might seem to. In ordinary scientific thinking, we rely on general principles of explanation to pass from the way the world first seems to us to a different conception of what it is really like. We try to explain the appearances in terms of a theory that describes the reality behind them, a reality that we can't observe directly. That is how physics and chemistry conclude that all the things we see around us are composed of invisibly small atoms. Could we argue that the general belief in the external world has the same kind of scientific backing as the belief in atoms?

The skeptic's answer is that the process of scientific reasoning raises the same skeptical problem we have been considering all along: Science is just as vulnerable as perception. How can we know that the world outside our minds corresponds to our ideas of what would be a good

theoretical explanation of our observations? If we can't establish the reliability of our sense experiences in relation to the external world, there's no reason to think we can rely on our scientific theories either.

There is another very different response to the problem. Some would argue that radical skepticism of the kind I have been talking about is meaningless, because the idea of an external reality that *no one* could ever discover is meaningless. The argument is that a dream, for instance, has to be something from which you *can* wake up to discover that you have been asleep; a hallucination has to be something which others (or you later) *can* see is not really there. Impressions and appearances that do not correspond to reality must be contrasted with others that *do* correspond to reality, or else the contrast between appearance and reality is meaningless.

According to this view, the idea of a dream from which you can never wake up is not the idea of a dream at all: it is the idea of *reality*— the real world in which you live. Our idea of the things that exist is just our idea of what we can observe. (This view is sometimes called verificationism.) Sometimes our observations are mistaken, but that means they can be corrected by other observations— as when you wake up from a dream or discover that what you thought was

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a snake was just a shadow on the grass. But without some possibility of a correct view of how things are (either yours or someone else's), the thought that your impressions of the world are not true is meaningless.

If this is right, then the skeptic is kidding himself if he thinks he can imagine that the only thing that exists is his own mind. He is kidding himself, because it couldn't be true that the physical world doesn't really exist, unless somebody could *observe* that it doesn't exist. And what the skeptic is trying to imagine is precisely that there *is* no one to observe that or anything else—except of course the skeptic himself, and all he can observe is the inside of his own mind. So solipsism is meaningless. It tries to subtract the external world from the totality of my impressions; but it fails, because if the external world is subtracted, they stop being mere impressions, and become instead perceptions of reality.

Is this argument against solipsism and skepticism any good? Not unless reality can be defined as what we can observe. But are we really unable to understand the idea of a real world, or a fact about reality, that can't be observed by anyone, human or otherwise?

The skeptic will claim that if there is an external world, the things in it are observable because

they exist, and not the other way around: that existence isn't the same thing as observability. And although we get the idea of dreams and hallucinations from cases where we think we *can* observe the contrast between our experiences and reality, it certainly seems as if the same idea can be extended to cases where the reality is not observable.

If that is right, it seems to follow that it is not meaningless to think that the world might consist of nothing but the inside of your mind, though neither you nor anyone else could find out that this was true. And if this is not meaningless, but is a possibility you must consider, there seems no way to prove that it is false, without arguing in a circle. So there may be no way out of the cage of your own mind. This is sometimes called the egocentric predicament.

And yet, after all this has been said, I have to admit it is practically impossible to believe seriously that all the things in the world around you might not really exist. Our acceptance of the external world is instinctive and powerful: we cannot just get rid of it by philosophical arguments. Not only do we go on acting *as if* other people and things exist: we *believe* that they do, even after we've gone through the arguments which appear to show we have no grounds for this belief. (We may have grounds, within the overall

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system of our beliefs about the world, for more particular beliefs about the existence of particular things: like a mouse in the breadbox, for example. But that is different. It assumes the existence of the external world.)

If a belief in the world outside our minds comes so naturally to us, perhaps we don't need grounds for it. We can just let it be and hope that we're right. And that in fact is what most people do after giving up the attempt to prove it: even if they can't give reasons against skepticism, they can't live with it either. But this means that we hold on to most of our ordinary beliefs about the world in face of the fact that (a) they might be completely false, and (b) we have no basis for ruling out that possibility.

We are left then with three questions:

1. Is it a meaningful possibility that the inside of your mind is the only thing that exists—or that even if there is a world outside your mind, it is totally unlike what you believe it to be?
2. If these things are possible, do you have any way of proving to yourself that they are not actually true?
3. If you can't prove that anything exists outside your own mind, is it all right to go on believing in the external world anyway?

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Other Minds

There is one special kind of skepticism which continues to be a problem even if you assume that your mind is not the only thing there is—that the physical world you seem to see and feel around you, including your own body, really exists. That is skepticism about the nature or even existence of minds or experiences other than your own.

How much do you really know about what goes on in anyone else's mind? Clearly you observe only the bodies of other creatures, including people. You watch what they do, listen to what they say and to the other sounds they make, and see how they respond to their environment—what things attract them and what things repel them, what they eat, and so forth. You can also cut open other creatures and look

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PERCEPTION

All is fish that comes to the net.

That we can gain knowledge through our senses seems so obvious that, at first, it may be hard to see that there are any difficulties here at all. One way to help you see that there *are* difficulties is to get you to abandon this world and travel to another...

Imagine that you wake up on a space-ship. You have been in suspended animation and have travelled to a distant galaxy. The space-ship crashes onto a planet. Looking out of the observation ports you see nothing but total blackness. You use the space-ship's instrumentation to assess the external environment. Bizarrely, outside the space-ship there is a blank in the part of the electro-magnetic spectrum that causes the light-sensitive cells in your eye to respond. There are plenty of other waves out there but you can't see them. How strange. But it gets stranger. There is also a blank in the spectrum of sound waves that exactly corresponds with the sound-waves your ears are sensitive to. There are plenty of other waves out there but you can't hear them. As your instruments scan through other physical properties you discover that this planet, besides being invisible and inaudible to you, cannot be tasted, smelt or felt. Nonetheless, the planet exists out there. It's just that *your* senses can't detect it.

You turn to your super-computer and programme it to convert the electro-magnetic and sound waves that are coming from the features of the planet into ones which your senses *can* appreciate. You instruct the computer to produce a complete hologram of the surface of the world and to project it in the Viewing Room.

You travel for several minutes down miles of corridors and enter a vast, silent, empty, windowless space: the Viewing Room. You stand

in the middle of the Room and utter the traditional command "*Let there be light*!" The computer instantly projects the hologram and the Viewing Room is filled with the image of the surface of the planet. You gaze around slowly. There are weird, fascinating shapes and colours and sounds and smells surrounding you. This is a fantastic, an amazing, a wonderful world.

But is the hologram a *true* representation of the planet you are on? The images that you are getting in the Viewing Room are *interpretations* of signals from the outside. You cannot possibly check that the computer has got it all right, that the shapes, colours, sounds and so on are a true match with the signals that its sensors are picking up from the actual planet's surface. That's because you, as a human, do not have the necessary *extra*-sensory perception required to carry out such a check (how could you see if the colour blue was really there if you can't detect the colour blue?). The hologram may appear extremely '*life-like*' but, in the end, it is only an image.

Now, let's return to Earth.

Look around you. What do you see? Obviously, you see a small part of the planet Earth. Where, precisely, do you 'see' this small part of the planet Earth? You will probably answer 'inside my brain'. This is because you know that light from the part of the planet around you enters your eyes and is converted into electrical impulses. These then pass into the brain where a picture of the world is projected into your brain's equivalent of the Viewing Room. But where exactly is this Viewing Room? The answer is astonishing: it's *outside* your brain. Your brain projects its 'hologram' of the planet Earth as if your eyes were two projectors and the space *outside* your brain and body were a room. To us it appears that we are peering out at the world through the observation ports we call eyes. But, of course, eyeballs are opaque when seen from behind. Our brain creates an illusion that we are looking at the real world. In fact, we are experiencing the brain's interpretations of the outside world which it projects outwards to give

us the impression that a real world exists 'out there'. In a real sense, we make up the world as we go along.

Before reading on, give yourself a few minutes to reflect on this remarkable aspect of your brain-power. Fully appreciating that what you have been thinking of as the world 'out there' is really an image that your brain is creating for you will almost certainly be startling, unsettling, thrilling and amazing.

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Right. Now let's get down to earth. What implications does all this have for our gaining of knowledge? Perhaps the most fundamental question we could ask would be "*How can I know that there is a real world out there at all?*" As in the story about the distant planet and the Viewing Room, we cannot check our senses are working properly because we need our senses to do the checking. Clearly, this is impossible - like trying to check the accuracy of a thermometer using only the thermometer itself.

One answer to this problem would be: We all confirm that a real world exists out there, independent of our brains, because we always agree in our 'projections'. When I am looking at a chair, everyone else around will agree that they too see the chair. This may prompt a deeper thought: "*How do I know other people are real? Couldn't they also be just images my brain is making up*?" This is a possibility but hardly a real one. If it were true, then you would have, for example, created all the world's great music and paintings, written all of Shakespeare's works, discovered penicillin, invented the computer, etc., etc. This is hard to claim, even for the vainest of us. (However, if you meet someone who *does* claim all this, then do feel free to insult them in the most withering terms: they will have to believe that they are insulting themselves since you are just a figment of their imagination.)

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The brain

Another approach to the problem would be to look at the brain itself to discover how it works and generates its images. If we find that it has a simple mechanism, where cause and effect are related in a straight-forward way, then this would give us some confidence that it is an honest interpreter of reality. Leaving aside the difficulty of checking a brain with a brain (the 'thermometer problem' again), when we look into a skull we find a mass of tiny, soft, wet, grey cells - no pictures of worlds or anything like it. In my analogy with the space-ship it would be like opening up the super-computer: there would be no pictures inside it either. To try to find out how the brain does its stuff you have to fiddle with it as you might do if you were told to find out how the supercomputer works; bash keys, stick a screw-driver into its innards, monitor the flow of electricity between components, slosh in varying amounts of power, experiment with the input and output ports and see if you can deduce any links between what you do and what happens on the screen. By doing these sorts of things, neuroscientists have helped towards an explanation of how the brain works. They have also discovered that the perception our brains have of the world can be mistaken.

False perception

The first problem lies with our sensory equipment. It is not perfect. Sometimes it will send a message to the brain when it has not received an appropriate signal; sometimes it will send a message but the brain never receives it. An example of the first is a persistent ringing sound in the ears for several hours after prolonged exposure to loud sounds. An example of the second is the chemical blocking of the nerve pathway by some anaesthetic or other. So, our senses are not entirely trustworthy but these examples will probably illustrate that it takes something fairly exceptional to make the input signals to the brain false ones.

A second problem lies in the mysterious something that we call 'consciousness' though we aren't certain what it is, let alone how it

works. It's not necessary for us to tackle this brute direct, but we will have to cast a swift glance in its direction because of its relationship to knowledge. This is particularly true of the sort of knowledge that we like to think we can *decide* to think about: conscious knowledge. Of all the millions of bits of information that flow into our brains every second only a small proportion enters our conscious mind so that we become aware of it. The rest (or nearly all of it anyway) gets lost. The 'decision' as to which bits of information enter our conscious mind is sometimes (or often) taken *sub*consciously. Thus, the subconscious mind monitors the incoming signals and 'decides' which ones are important enough to send to the conscious mind. A simple illustration of this is the crowded room where many people are, like you, chatting to friends. While you listen to your friend, everyone else's conversation makes a background buzz. Suddenly, you hear your name mentioned nearby and look round to see who is talking about you. For this sort of thing to happen your brain must have been monitoring *all* the conversations within earshot. For most of the time nothing of interest was coming in and so the subconscious brain toned it down to a buzz. Then, something important to you cropped up - *your name was mentioned* - and your subconscious immediately made you aware of it. Hence, the knowledge that you get into your conscious brain (the knowledge you *perceive*) passes through a subconscious process that we seem to have little, if any, control over. This is a bit limiting: we may be losing potential knowledge all the time because our subconscious is rejecting it as unimportant or 'boring'. (This might be why schoolwork is so hard.)

Two further problems in perception are ambiguity and illusion. Sometimes the brain receives information that is capable of being interpreted in more than one way: it is ambiguous. We are usually aware that there are more ways of interpreting the information and can resolve the problem by looking for more data. But are we always aware that a certain piece of perceived information *is* ambiguous? Might we just accept what we perceive as being the case? A simple example is the Moon which looks like a disc and like a sphere - it

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could be either as we view it from Earth. Most of us are confident that it is a sphere but it is not hard to imagine that a few thousand years ago this possibility had not even been thought of. Just as the possibility that the moon is the end of a long tube that points at us like the barrel of a gun may not have crossed your mind until now; but it is another interpretation. This is another way of saying that our knowledge is incomplete.

An illusion is the result of the brain receiving perfectly adequate information but which it then 'distorts' to fit in with its expectations: it expects the world out there to conform to certain patterns, and incoming information is moulded to fit. There are many visual illusions which confirm that this is so. Our concern here is that we may be counting some things as 'knowledge' when they are illusions. One tentative answer to this concern is to say that if our knowledge of the world were illusory in any important degree then we would have made lots of mistakes in the past and not survived in the Darwinian struggle for existence. The fact that we are here is a strong affirmation that the world is as we perceive it.

INTUITION

It is idle to swallow a cow and choke on its tail.

Apart from reason and perception, what I am calling intuition is another way of gaining knowledge of the world. It has been described as emotional, or irrational, or nonrational, thinking but, since these terms carry rather negative overtones, I prefer the term intuition. I would define it as *unguided* thinking. This distinguishes it from reason (which is objective and open to rational argument) and from perception (which deals with the relationship between our minds and the rest of the world). I would say that it is unguided because it seems that we cannot *generate* such thinking nor exercise much, if any, control over where it leads us.

Some examples of intuitive thinking would include: feeling what sort of behaviour is right; appreciating the beauty of an object; betting on a certain number because you know it is going to come up. It is often regarded as the sort of thinking that separates human beings from other forms of life and, indeed, from machines which might be capable of perceiving the world and reasoning about it in the same way as we do. Many see it as integral to such things as creativity, imagination, wonder, love and euphoria; with guilt, anguish, fear, hate and horror. But most of all, it is generally associated with free will, the sense we have that we can determine what we are going to do in the world. Thus, it is of great significance to us all.

Intuitive thinking has a distinguished pedigree. Homer's heroes were inspired and informed by it. It has often been associatied with the most exalted areas of human achievement including poetry, art, music - indeed, 'humanity' itself. In the modern world it still exercises a powerful influence over our every-day lives when we are 'being ourselves' or 'listening to our inner voice'. Though intuition has usually

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Taken from Einstein's Dreams
by Alan Lightman

• 14 April 1905

Suppose time is a circle, bending back on itself. The world repeats itself, precisely, endlessly.

For the most part, people do not know they will live their lives over. Traders do not know that they will make the same bargain again and again. Politicians do not know that they will shout from the same lectern an infinite number of times in the cycles of time. Parents treasure the first laugh from their child as if they will not hear it again. Lovers making love the first time undress shyly, show surprise at the supple thigh, the fragile nipple. How would they know that each secret glimpse, each touch, will be repeated again and again and again, exactly as before?

On Marktgasse, it is the same. How could the shopkeepers know that each handmade sweater, each embroidered handkerchief, each chocolate candy, each intricate compass and watch will return to their stalls? At dusk, the shopkeepers go home to their families or drink beer in the taverns, calling happily to friends down the vaulted alleys, caressing each moment as an emerald on temporary consignment. How could they know that nothing is temporary, that all will happen again? No more than an ant crawling round the rim of a crystal chandelier knows that it will return to where it began.

In the hospital on Gerberngasse, a woman says goodbye to her husband. He lies in bed and stares at her emptily. In the last two months, his cancer has spread from his throat to his liver, his pancreas, his brain. His two young children sit on one chair in the corner of the room, frightened to look at their father, his sunken cheeks, the withered skin of an old man. The wife comes to the bed and kisses her husband softly on the forehead, whispers goodbye, and quickly leaves with the children. She is certain that this was the last kiss. How could she

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know that time will begin again, that she will be born again, will study at the gymnasium again, will show her paintings at the gallery in Zürich, will again meet her husband in the small library in Fribourg, will again go sailing with him in Thun Lake on a warm day in July, will give birth again, that her husband will again work for eight years at the pharmaceutical and come home one evening with a lump in his throat, will again throw up and get weak and end up in this hospital, this room, this bed, this moment. How could she know?

In the world in which time is a circle, every handshake, every kiss, every birth, every word, will be repeated precisely. So too every moment that two friends stop becoming friends, every time that a family is broken because of money, every vicious remark in an argument between spouses, every opportunity denied because of a superior's jealousy, every promise not kept.

And just as all things will be repeated in the future, all things now happening happened a million times before. Some few people in every town, in their dreams, are vaguely aware that all has occurred in the past. These are the people with unhappy lives, and they sense that their misjudgments and wrong deeds and bad luck have all taken place in the previous

loop of time. In the dead of night these cursed citizens wrestle with their bedsheets, unable to rest, stricken with the knowledge that they cannot change a single action, a single gesture. Their mistakes will be repeated precisely in this life as in the life before. And it is these double unfortunates who give the only sign that time is a circle. For in each town, late at night, the vacant streets and balconies fill up with their moans.

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• 24 April 1905

In this world, there are two times. There is mechanical time and there is body time. The first is as rigid and metallic as a massive pendulum of iron that swings back and forth, back and forth, back and forth. The second squirms and wriggles like a bluefish in a bay. The first is unyielding, predetermined. The second makes up its mind as it goes along.

Many are convinced that mechanical time does not exist. When they pass the giant clock on the Kramgasse they do not see it; nor do they hear its chimes while sending packages on

Postgasse or strolling between flowers in the Rosengarten. They wear watches on their wrists, but only as ornaments or as courtesies to those who would give timepieces as gifts. They do not keep clocks in their houses. Instead, they listen to their heartbeats. They feel the rhythms of their moods and desires. Such people eat when they are hungry, go to their jobs at the millinery or the chemist's whenever they wake from their sleep, make love all hours of the day. Such people laugh at the thought of mechanical time. They know that time moves in fits and starts. They know that time struggles forward with a weight on its back when they are rushing an injured child to the hospital or bearing the gaze of a neighbor wronged. And they know too that time darts across the field of vision when they are eating well with friends or receiving praise or lying in the arms of a secret lover.

Then there are those who think their bodies don't exist. They live by mechanical time. They rise at seven o'clock in the morning. They eat their lunch at noon and their supper at six. They arrive at their appointments on time, precisely by the clock. They make love between eight and ten at night. They work forty hours a week, read the Sunday paper on Sunday, play chess on Tuesday nights. When their stomach growls, they

look at their watch to see if it is time to eat. When they begin to lose themselves in a concert, they look at the clock above the stage to see when it will be time to go home. They know that the body is not a thing of wild magic, but a collection of chemicals, tissues, and nerve impulses. Thoughts are no more than electrical surges in the brain. Sexual arousal is no more than a flow of chemicals to certain nerve endings. Sadness no more than a bit of acid transfixed in the cerebellum. In short, the body is a machine, subject to the same laws of electricity and mechanics as an electron or clock. As such, the body must be addressed in the language of physics. And if the body speaks, it is the speaking only of so many levers and forces. The body is a thing to be ordered, not obeyed.

Taking the night air along the river Aare, one sees evidence for two worlds in one. A boatman gauges his position in the dark by counting seconds drifted in the water's current. "One, three meters. Two, six meters. Three, nine meters." His voice cuts through the black in clean and certain syllables. Beneath a lamppost on the Nydegg Bridge, two brothers who have not seen each other for a year stand and drink and laugh. The bell of St. Vincent's Cathedral sings ten times. In seconds, lights in the apartments lining Schifflaube wink out, in a perfect mechanized response, like the deductions of Euclid's geometry. Lying on the riverbank, two lovers look up lazily, awakened from a timeless sleep by the distant church bells, surprised to find that night has come.

Where the two times meet, desperation. Where the two times go their separate ways, contentment. For, miraculously, a barrister, a nurse, a baker can make a world in either time, but not in both times. Each time is true, but the truths are not the same.

"'From the beginning, I found myself writing of science, my first passion and profession, sometimes of the hard facts of science but more often of the human texture and whimsy, the lived part of science. Science, for me, was the most rigorous and extreme expression of order in the physical world. Yet the desire for that order, and often the means to declare it, were human, oddly nestled against the emotion and wild flight of the human world. Where those two worlds met seemed a subject for literature. And I was partly propelled by something I'd learned from watching my colleagues: Scientists often make their greatest discoveries just at those moments when they follow their intuition instead of equations. In other words, when they behave the least 'scientifically.' That secret, known to historians but rarely to scientists, became the hidden thread running through my essays."
- Alan Lightman

SMILE
by Alan Lightman

IT IS A SATURDAY IN MARCH. The man wakes up slowly, reaches over and feels the windowpane, and decides it is warm enough to skip his thermal underwear. He yawns and dresses and goes out for his morning jog. When he comes back, he showers, cooks himself a scrambled egg, and settles down on the sofa with *The Essays of E. B. White*. Around noon, he rides his bike to the bookstore. He spends a couple of hours there, just poking around the books. Then he pedals back through the little town, past his house, and to the lake.

When the woman woke up this morning, she got out of bed and went immediately to her easel, where she picked up her pastels and set to work on her painting. After an hour, she is satisfied with the light effect and quits to have breakfast. She dresses quickly and walks to a nearby store to buy shutters for her bathroom. At the store, she meets friends and has lunch with them. Afterward, she wants to be alone and drives to the lake.

Now, the man and the woman stand on the wooden dock, gazing at the lake and the waves on the water. They haven't noticed each other.

The man turns. And so begins the sequence of events informing him of her. Light reflected from her body instantly enters the pupils of his eyes, at the rate of ten trillion particles of light per second. Once through the pupil of each eye, the light travels through an oval-shaped lens, then through a transparent, jellylike substance filling up the eyeball, and lands on the retina. Here it is gathered by one hundred million rod and cone cells.

Cells in the path of the reflected highlights receive a great deal of light; cells falling in the shadows of the reflected scene receive very little. The woman's lips, for example, are just now glistening in the sunlight, reflecting light of high intensity onto a tiny patch of cells slightly northeast of back center of the man's retina. The edges around her mouth, on the other hand, are rather dark, so that cells neighboring the northeast path receive much less light.

Each particle of light ends its journey in the eye upon meeting a retinene molecule, consisting of 20 carbon atoms, 28 hydrogen atoms, and 1 oxygen atom. In its dormant condition, each retinene molecule is attached to a protein molecule and has a twist between the eleventh and fifteenth carbon atoms. But when light strikes it, as is now happening in about 30,000 trillion retinene molecules every second, the molecule straightens out and separates from its protein. After several intermediate steps, it wraps into a twist again, awaiting arrival of a new particle of light. Far less than a thousandth of a second has elapsed since the man saw the woman.

Triggered by the dance of the retinene molecules, the nerve cells, or neurons, respond. First in the eye and then in the brain. One neuron, for instance, has just gone into action. Protein

molecules on its surface suddenly change their shape, blocking the flow of positively charged sodium atoms from the surrounding body fluid. This change in flow of electrically charged atoms produces a change in voltage that shudders through the cell. After a distance of a fraction of an inch, the electrical signal reaches the end of the neuron, altering the release of specific molecules, which migrate a distance of a hundred-thousandth of an inch until they reach the next neuron, passing along the news.

The woman, in fact, holds her hands by her sides and tilts her head at an angle of five and a half degrees. Her hair falls just to her shoulders. This information and much, much more is exactingly encoded by the electrical pulses in the various neurons of the man's eyes.

In another few thousandths of a second, the electrical signals reach the ganglion neurons, which bunch together in the optic nerve at the back of the eye and carry their data to the brain. Here, the impulses race to the primary visual cortex, a highly folded layer of tissue about a tenth of an inch thick and two square inches in area, containing one hundred million neurons in half a dozen layers. The fourth layer receives the input first, does a preliminary analysis, and transfers the information to neurons in other layers. At every stage, each neuron may receive signals from a thousand other neurons, combine the signals - some of which cancel each other out - and dispatch the computed result to a thousand-odd other neurons.

After about thirty seconds - after several hundred trillion particles of reflected light have entered the man's eyes and been processed - the woman says hello. Immediately, molecules of air are pushed together, then apart, then together, beginning in her vocal cords and traveling in a spring like motion to the man's ears. The sound makes the trip from her to him (twenty feet) in a fiftieth of a second.

Within each of his ears, the vibrating air quickly covers the distance to the eardrum. The eardrum, an oval membrane about .3 inch in diameter and tilted fifty-five degrees from the floor of the auditory canal, itself begins trembling and transmits its motion to three tiny bones. From there, the vibrations shake the fluid in the cochlea, which spirals snail-like two and a half turns around.

Inside the cochlea the tones are deciphered. Here, a very thin membrane undulates in step with the sloshing fluid, and through this basilar membrane run tiny filaments of varying thickness, like strings on a harp. The woman's voice, from afar, is playing this harp. Her hello begins in a low registers and rises in pitch toward the end. In precise response, the thick filaments in the basilar membrane vibrate first, followed by the thinner ones. Finally, tens of thousands of rod-shaped bodies perched on the basilar membrane convey their particular quiverings to the auditory nerve.

News of the woman's hello, in electrical form, races along the neurons of the auditory nerve and enters the man's brain, through the thalamus, to a specialized region of the cerebral cortex for further processing. Eventually, a large fraction of the trillion neurons in the man's brain become involved with computing the visual and auditory data just acquired. Sodium and potassium gates open and close. Electrical currents speed along neuron fibers. Molecules flow from one nerve ending to the next.

All of this is known. What is not known is why, after about a minute, the man walks over to the woman and smiles.

Solipsist

Walter B. Jehovah, for whose name I make no apology since it really was his name, had been a solipsist all his life. A solipsist, in case you don't happen to know the word, is one who believes that he himself is the only thing that really exists, that other people and the universe in general exist only in his imagination, and that if he quit imagining them, they would cease to exist.

One day, Walter B. Jehovah became a practicing solipsist. Within a week, his wife had run away with another man, he'd lost his job as a shipping clerk and he had broken his leg chasing a black cat to keep it from crossing his path.

He decided, in a hospital, to end it all.

Looking out the window, staring up at the stars, he wished them out of existence, and they weren't there anymore. Then he wished all other people out of existence, and the hospital became strangely quiet, even for a hospital. Next the world, and he found himself suspended in a void. He got rid of his body quite easily and then took the final step of willing *himself* out of existence.

Nothing happened.

Strange, he thought, can there be a limit to solipsism?

"Yes" a voice said.

"Who are you?" Walter B. Jehovah asked.

"I am the one who created the universe which you have just willed out of existence. And now that you have taken my place-" there was a deep sigh "-I can finally cease my own existence, find oblivion, and let you take over."

"But-how can *I* cease to exist? That's what I'm trying to do, you know."

"Yes, I know," said the voice. "You must do it the same way I did. Create a universe. Wait until someone in it really believes what you believed and wills it out of existence. Then you can retire and let him take over. Good-by now."

And the voice was gone. Walter B. Jehovah was alone in the void and there was only one thing he could do. He created the heaven and the earth.

It took him seven days

TOK- Wars

The Tao de Ching
By Lao Tzu

1

Existence is beyond the power of words
To define:
Terms may be used
But are none of them absolute.
In the beginning of heaven and earth there was no words,
Words came out of the womb of matter;
And whether a man dispassionately
Sees to the core of life
Or passionately
Sees the surface,
The core and the surface
Are essentially the same,
Words making them seem different
Only to express appearance.
If named be needed, wonder names them both:
From wonder into wonder
Existence opens.

2

People through finding something beautiful
Think something else unbeautiful,
Through finding one man fit
Judge another unfit.
Life and death, though stemming each other, seem to conflict as stages of change.
Difficult and easy as phases of achievement,
Long and short as measures of contrast,
High and low as degrees of relation;
But, since the varying of tones gives music to a voice
And what is is the was of what shall be,
The sanest man
Sets up no deed,
Lays down no law,

Takes everything that happens as it comes,
As something to animate, not to appropriate,
To earn, not own,
To accept naturally without self-importance:
If you never assume importance
You never lose it.

3

It is better not to make merit a matter of reward
Lest people conspire and contend,
Not to pile up rich belongings
Lest they rob,
Not to excite by display
Lest they covet.
A sound leader's aim
Is to open people's hearts,
Fill their stomachs,
Calm their wills,
Brace their bones
And so to clarify their thoughts and cleanse their needs
That no cunning meddler could touch them:
Without being forced, without strain or constraint,
Good government comes of itself.

4

Existence, by nothing to bred,
Breeds everything.
Parent of the universe,
It smooths rough edges,
Unties hard knots,
Tempers the sharp sun,
Lays blowing dust,
Its image in the wellspring never fails.

But how was it conceived?—this image
Of no other sire.

5

Nature, immune as to a sacrifice of straw dogs,
Faces the decay of its fruits.
A sound man, immune as to a sacrifice of straw dogs.
Faces the passing of human generations.
The universe, like a bellows,
Is always emptying, always full:
The more it yields, the more it holds.
Men come to their wit's end arguing about it
And had better meet it at the marrow.

6

The breath of life moves through a deathless valley
Of mysterious motherhood
Which conceives and bears the universal seed,
The seeming of a world never to end,
Breath for men to draw from as they will:
And the more they take of it, the more remains.

7

The universe is deathless,
Is deathless because, having no finite self,
It stays infinite.
A sound man by not advancing himself
Stays the further ahead of himself,
By not confining himself to himself
Sustains himself outside himself:

(2) He never brings an end in himself
He endlessly becomes himself.