

SETTING SCIENCE FREE FROM MATERIALISM

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Contemporary science is based on the claim that all reality is material or physical. There is no reality but material reality. Consciousness is a by-product of the physical activity of the brain. Matter is unconscious. Evolution is purposeless. This view is now undergoing a credibility crunch. The biggest problem of all for materialism is the existence of consciousness. Panpsychism provides a way forward. So does the recognition that minds are not confined to brains.

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The “scientific worldview” is immensely influential because the sciences have been so successful. No one can fail to be awed by their achievements, which touch all our lives through technologies and through modern medicine. Our intellectual world has been transformed through an immense expansion of our knowledge, down into the most microscopic particles of matter and out into the vastness of space, with hundreds of billions of galaxies in an ever-expanding universe.

Yet in the second decade of the 21st century, when science and technology seem to be at the peak of the power, when their influence has spread all over the world, and when their triumph seems indisputable, unexpected problems are disrupting the sciences from within. Most scientists take it for granted that these problems will eventually be solved by more research along established lines, but some, including myself, think that they are symptoms of a deeper malaise. Science is being held back by centuries-old assumptions that have hardened into dogmas. The sciences would be better off without them: freer, more interesting, and more fun.

The biggest scientific delusion of all is that science already knows the answers. The details still need working out, but the fundamental questions are settled, in principle.

Contemporary science is based on the claim that all reality is material or physical. There is no reality but material reality. Consciousness is a by-product of the physical activity of the brain. Matter is unconscious. Evolution is purposeless. God exists only as an idea in human minds, and hence in human heads.

These beliefs are powerful not because most scientists think about them critically, but because they do not. The facts of science are real enough, and so are the techniques that scientists use, and so are the technologies based on them. But the belief system that governs conventional scientific thinking is an act of faith, grounded in a 19th-century ideology.

THE SCIENTIFIC CREED

Here are the 10 core beliefs that most scientists take for granted.

1. Everything is essentially mechanical. Dogs, for example, are complex mechanisms, rather than living organisms with goals of their own. Even people are machines, “lumbering robots,” in Richard Dawkins' vivid phrase, with brains that are like genetically programmed computers.
2. All matter is unconscious. It has no inner life or subjectivity or point of view. Even human consciousness is an illusion produced by the material activities of brains.
3. The total amount of matter and energy is always the same (with the exception of the Big Bang, when all the matter and energy of the universe suddenly appeared).
4. The laws of nature are fixed. They are the same today as they were at the beginning, and they will stay the same forever.
5. Nature is purposeless, and evolution has no goal or direction.
6. All biological inheritance is material, carried in the genetic material, DNA, and in other material structures.
7. Minds are inside heads and are nothing but the activities of brains. When you look at a tree, the image of the tree you are seeing is not “out there,” where it seems to be, but inside your brain.
8. Memories are stored as material traces in brains and are wiped out at death.
9. Unexplained phenomena like telepathy are illusory.
10. Mechanistic medicine is the only kind that really works.

Together, these beliefs make up the philosophy or ideology of materialism, whose central assumption is that everything is essentially material or physical, even minds. This belief system became dominant within science in the late 19th century, and is now taken for granted. Many scientists are unaware that materialism is an assumption; they simply think of it as science, or the scientific view of reality, or the scientific

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worldview. They are not actually taught about it, or given a chance to discuss it. They absorb it by a kind of intellectual osmosis.

In everyday usage, materialism refers to a way of life devoted entirely to material interests, a preoccupation with wealth, possessions, and luxury. These attitudes are no doubt encouraged by the materialist philosophy, which denies the existence of any spiritual realities or non-material goals, but in this article I am concerned with materialism's scientific claims, rather than its effects on lifestyles.

In the spirit of radical skepticism, each of these 10 doctrines can be turned into a question, as I show in my book *Science Set Free*¹ (called *The Science Delusion* in the UK). Entirely new vistas open up when a widely accepted assumption is taken as the beginning of an inquiry, rather than as an unquestionable truth. For example, the assumption that nature is machine-like or mechanical becomes a question: "Is nature mechanical?" The assumption that matter is unconscious becomes "Is matter unconscious?" and so on.

THE CREDIBILITY CRUNCH FOR THE "SCIENTIFIC WORLDVIEW"

For more than 200 years, materialists have promised that science will eventually explain everything in terms of physics and chemistry. Science will prove that living organisms are complex machines, minds are nothing but brain activity, and nature is purposeless. Believers are sustained by the faith that scientific discoveries will justify their beliefs. The philosopher of science Karl Popper called this stance "promissory materialism" because it depends on issuing promissory notes for discoveries not yet made.² Despite all the achievements of science and technology, materialism is now facing a credibility crunch that was unimaginable in the 20th century.

In 1963, when I was studying biochemistry at Cambridge University, I was invited to a series of private meetings with Francis Crick and Sydney Brenner in Brenner's rooms in King's College, along with a few of my classmates. Crick and Brenner had recently helped to "crack" the genetic code. Both were ardent materialists and Crick was also a militant atheist. They explained there were two major unsolved problems in biology: development and consciousness. They had not been solved because the people who worked on them were not molecular biologists—nor very bright. Crick and Brenner were going to find the answers within 10 years, or maybe 20. Brenner would take developmental biology, and Crick consciousness. They invited us to join them.

Both tried their best. Brenner was awarded the Nobel Prize in 2002 for his work on the development of a tiny worm, *Caenorhabditis elegans*. Crick corrected the manuscript of his final paper on the brain the day before he died in 2004. At his funeral, his son Michael said that what made him tick was not the desire to be famous, wealthy, or popular, but "to knock the final nail into the coffin of vitalism." (Vitalism is the theory that living organisms are truly alive, and not explicable in terms of physics and chemistry alone.)

Crick and Brenner failed. The problems of development and consciousness remain unsolved. Many details have been discovered, dozens of genomes have been sequenced, and

brain scans are ever more precise. But there is still no proof that life and minds can be explained by physics and chemistry alone.

The fundamental proposition of materialism is that matter is the only reality. Therefore consciousness is nothing but brain activity. It is either like a shadow, an "epiphenomenon," that does nothing, or it is just another way of *talking* about brain activity. However, among contemporary researchers in neuroscience and consciousness studies there is no consensus about the nature of minds. Leading journals such as *Behavioural and Brain Sciences* and the *Journal of Consciousness Studies* publish many articles that reveal deep problems with the materialist doctrine. The philosopher David Chalmers has called the very existence of subjective experience the "hard problem." It is hard because it defies explanation in terms of mechanisms. Even if we understand how eyes and brains respond to red light, the *experience* of redness is not accounted for.

In biology and psychology the credibility rating of materialism is falling. Can physics ride to the rescue? Some materialists prefer to call themselves physicalists, to emphasize that their hopes depend on modern physics, not 19th-century theories of matter. But physicalism's own credibility rating has been reduced by physics itself, for four reasons:

First, some physicists insist that quantum mechanics cannot be formulated without taking into account the minds of observers. They argue that minds cannot be reduced to physics because physics presupposes the minds of physicists.³

Second, the most ambitious unified theories of physical reality, string and M-theories, with 10 and 11 dimensions, respectively, take science into completely new territory. Strangely, as Stephen Hawking tells us in his book *The Grand Design* (2010), "No one seems to know what the 'M' stands for, but it may be 'master', 'miracle' or 'mystery'." According to what Hawking calls "model-dependent realism," different theories may have to be applied in different situations. "Each theory may have its own version of reality, but according to model-dependent realism, that is acceptable so long as the theories agree in their predictions whenever they overlap, that is, whenever they can both be applied."⁴

String theories and M-theories are currently untestable, so "model-dependent realism" can only be judged by reference to other models, rather than by experiment. It also applies to countless other universes, none of which has ever been observed.⁵

Some physicists are deeply skeptical about this entire approach, as the theoretical physicist Lee Smolin shows in his book *The Trouble With Physics: The Rise of String Theory, the Fall of a Science and What Comes Next* (2008).⁶ String theories, M-theories, and "model-dependent realism" are a shaky foundation for materialism or physicalism or any other belief system.

Third, since the beginning of the 21st century, it has become apparent that the known kinds of matter and energy make up only about 4% of the universe. The rest consists of "dark matter" and "dark energy." The nature of 96% of physical reality is literally obscure.

Fourth, the Cosmological Anthropic Principle asserts that if the laws and constants of nature had been slightly different at the moment of the Big Bang, biological life could never have emerged, and hence we would not be here to think about it. So

did a divine mind fine-tune the laws and constants in the beginning? To avoid a creator God emerging in a new guise, most leading cosmologists prefer to believe that our universe is one of a vast, and perhaps infinite, number of parallel universes, all with different laws and constants, as M-theory also suggests. We just happen to exist in the one that has the right conditions for us.⁷

This multiverse theory is the ultimate violation of Ockham's Razor, the philosophical principle that "entities must not be multiplied beyond necessity," or in other words that we should make as few assumptions as possible. It also has the major disadvantage of being untestable.⁸ And it does not even succeed in getting rid of God. An infinite God could be the God of an infinite number of universes.⁹

Materialism provided a seemingly simple, straightforward worldview in the late 19th century, but 21st century science has left it far behind. Its promises have not been fulfilled, and its promissory notes have been devalued by hyperinflation.

I am convinced that the sciences are being held back by assumptions that have hardened into dogmas, maintained by powerful taboos. These beliefs protect the citadel of established science, but act as barriers against open-minded thinking. Here, for example, I explore Dogma 2, the assumption that matter is unconscious

IS MATTER UNCONSCIOUS?

The central doctrine of materialism is that matter is the only reality. Therefore, consciousness ought not to exist. Materialism's biggest problem is that consciousness does exist. You are conscious now. The main opposing theory, dualism, accepts the reality of consciousness, but has no convincing explanation for its interaction with the body and the brain. Dualist-materialist arguments have gone on for centuries. But if we question the dogma that matter is unconscious, we can move forward from this sterile opposition.

Scientific materialism arose historically as a rejection of mechanistic dualism, which defined matter as unconscious and souls as immaterial, as I discuss below. One important motive for this rejection was the elimination of souls and God, leaving unconscious matter as the only reality. In short, materialists treated subjective experience as irrelevant; dualists accepted the reality of experience but were unable to explain how minds affect brains.

The materialist philosopher Daniel Dennett wrote a book called *Consciousness Explained* (1991), in which he tried to explain away consciousness by arguing that subjective experience is illusory. He was forced to this conclusion because he rejected dualism as a matter of principle:

I adopt the apparently dogmatic rule that dualism is to be avoided *at all costs*. It is not that I think I can give a knock-down proof that dualism, in all its forms, is false or incoherent, but that, given the way that dualism wallows in mystery, *accepting dualism is giving up* [his italics].¹⁰

This dogmatism of Dennett's rule is not merely apparent: the rule is dogmatic. By "giving up" and "wallowing in mystery," I suppose he means giving up science and reason and relapsing into religion and superstition. Materialism "at

all costs" demands the denial of the reality of our own minds and personal experiences—including those of Daniel Dennett himself, although by putting forward arguments he hopes will be persuasive, he seems to make an exception for himself and for those who read his book.

Francis Crick devoted decades of his life to trying to explain consciousness mechanistically. He frankly admitted that the materialist theory was an "astonishing hypothesis" that flew in the face of common sense: "'You', your joys, and your sorrows, your memories and your ambitions, and your sense of personal identity and free will are in fact no more than the behavior of a vast assembly of nerve cells and their associated molecules."¹¹ Presumably Crick included himself in this description, although he must have felt that here was more to his argument than the automatic activity of nerve cells.

One of the motives of materialists is to support an anti-religious worldview. Francis Crick was a militant atheist, as is Daniel Dennett. On the other hand, one of the traditional motives of dualists is to support the possibility of the soul's survival. If the human soul is immaterial, it may exist after bodily death.

Scientific orthodoxy has not always been materialist. The founders of mechanistic science in the 17th century were dualistic Christians. They downgraded matter, making it totally inanimate and mechanical, and at the same time upgraded human minds making them completely different from unconscious matter. By creating an unbridgeable gulf between the two, they thought they were strengthening the argument for the human soul and its immortality, as well as increasing the separation between humans and other animals.

This mechanistic dualism is often called Cartesian dualism after Descartes (Des Cartes). It saw the human mind as essentially immaterial and disembodied, and bodies as machines made of unconscious matter.¹² In practice, most people take a dualist view for granted, as long as they are not called upon to defend it. Almost everyone assumes that we have some degree of free will, and are responsible for our actions. Our educational and legal systems are based on this belief. And we experience ourselves as conscious beings, with some degree of free choice. Even to discuss consciousness presupposes that we are conscious ourselves. Nevertheless, since the 1920s, most leading scientists and philosophers in the English-speaking world have been materialists, in spite of all the problems this doctrine creates.

The strongest argument in favor of materialism is the failure of dualism to explain how immaterial minds work and how they interact with brains. The strongest argument in favor of dualism is the implausibility and self-contradictory nature of materialism.

The dualist-materialist dialectic has lasted for centuries. The soul-body or mind-brain problem has refused to go away. But before we can move forward, first we need to understand in more detail what materialists claim, since their belief system dominates institutional science and medicine, and everyone is influenced by it.

MINDS THAT DENY THEIR OWN REALITY

Most neuroscientists do not spend much time thinking about the logical problems that materialist beliefs entail. They just

get on with the job of trying to understand how brains work, in the faith that more hard facts will eventually provide answers. They leave professional philosophers to defend the materialist or physicalist faith.

Physicalism means much the same as materialism, but rather than asserting that all reality is material, it asserts that it is physical, explicable in terms of physics, and hence including energy and fields as well as matter. In practice, this is what materialists believe too. In the following discussion I use the more familiar word materialism to mean “materialism or physicalism.”

Among materialist philosophers there are several schools of thought. The most extreme position is called “eliminative materialism.” Consciousness is just an “aspect” of the activity of the brain. Thoughts or sensations are just another way of talking about activity in particular regions of the cerebral cortex; they are the same things talked about in different ways.

Other materialists are “epiphenomenalists”: they accept rather than deny the existence of consciousness, but see it as a functionless by-product of the activity of the brain, an “epiphenomenon,” like a shadow. People might just as well be zombies, with no subjective experience, because all their behavior is a result of brain activity alone. Conscious experience does nothing, and makes no difference to the physical world.

A recent form of materialism is “cognitive psychology,” which dominated academic psychology in the English-speaking world in the late twentieth century. It treats the brain as a computer and mental activity as information processing. Subjective experiences, like seeing green, or feeling pain, or enjoying music, are computational processes inside the brain, which are themselves unconscious.

Some philosophers, like John Searle, think that minds can emerge from matter by analogy with the way that physical properties can emerge at different levels of complexity, like the wetness of water emerging from the interactions of large numbers of water molecules. Many non-materialists would agree with Searle that consciousness is in some sense “emergent” but would argue that while mind and conscious agency originate in physical nature, they are qualitatively different from purely material or physical being.

Finally, some materialists hope that evolution can provide an answer. They propose that consciousness emerged as a result of natural selection through mindless processes from unconscious matter. Because minds evolved, they must have been favored by natural selection, and hence they must actually do something; they must make a difference. Many non-materialists would agree. But materialists want to have it both ways: emergent consciousness must do something if it has evolved as an evolutionary adaptation favored by natural selection; but it cannot do anything if it is just an epiphenomenon of the brain activity, or another way of talking about brain mechanisms. In 2011, the psychologist Nicholas Humphrey tried to overcome this problem by suggesting that consciousness evolved because it helps humans survive and reproduce by making us feel “special and transcendent.” But as a materialist, Humphrey does not agree that our minds have any agency, that is to say, they cannot affect our actions. Instead our consciousness is illusory: he describes it as “a magical mystery show that we stage for ourselves inside

our own heads.”¹³ But to say that consciousness is an illusion does not explain consciousness—it presupposes it. Illusion is a mode of consciousness.

If all these theories sound unconvincing, that is because they are. They do not even convince other materialists, which is why there are so many rival theories. Searle has described the debate over the last 50 years as follows:

A philosopher advances a materialist theory of the mind... He then encounters difficulties... Criticisms of the materialist theory usually take a more or less technical form, but, in fact, underlying the technical objections is a much deeper objection: the theory in question has left out some essential feature of the mind... And this leads to ever more frenzied attempts to stick with the materialist thesis.¹⁴

The philosopher Galen Strawson, himself a materialist, is amazed by the willingness of so many of his fellow philosophers to deny the reality of their own experience:

I think we should feel very sober, and a little afraid, at the power of human credulity, the capacity of human minds to be gripped by theory, by faith. For this particular denial is the strangest thing that has ever happened in the whole history of human thought, not just the whole history of philosophy.¹⁵

Francis Crick admitted that the “astonishing hypothesis” was not proved. He conceded that a dualist view might become more plausible. But, he added, “There is always a third possibility: that the facts support a new, alternative way of looking at the mind–brain problem that is significantly different from the rather crude materialistic view that many neuroscientists hold today and also from the religious point of view. Only time, and much further scientific work, will enable us to decide.”¹⁶

There is indeed a third way.

PANPSYCHIST ALTERNATIVES

Galen Strawson shares the frustration of many contemporary philosophers with the seemingly intractable problems of materialism and of dualism. He has come to the conclusion that there is only one way out. He argues that a consistent materialism must imply panpsychism, namely the idea that even atoms and molecules have a primitive kind of mentality or experience. (The Greek word *pan* means everywhere, and *psyche* means soul or mind.) Panpsychism does not mean that atoms are conscious in the sense that we are, but only that some aspects of mentality or experience are present in the simplest physical systems. More complex forms of mind or experience emerge in more complex systems.¹⁵

In 2006, the *Journal of Consciousness Studies* published a special issue entitled “Does materialism entail panpsychism?” with a target article by Strawson, and responses by 17 other philosophers and scientists. Some of them rejected his suggestion in favor of more conventional kinds of materialism, but all admitted that their favored kind of materialism was problematic.

Strawson made only a generalized, abstract case for panpsychism, with disappointingly few details as to how an

electron or an atom could be said to have experiences. But like many other panpsychists, he made an important distinction between aggregates of matter, like tables and rocks, and self-organizing systems like atoms, cells, and animals. He did not suggest that tables and rocks have any unified experience, though the atoms within them may have.¹⁵ The reason for this distinction is that man-made objects like chairs or cars do not organize themselves, and do not have their own goals or purposes. They are designed by people and put together in factories. Likewise rocks are made up of atoms and crystals that are self-organizing, but external forces shape the rock as a whole: for example it may have been split from a larger rock as a boulder rolled down a mountain.

By contrast, in *self-organizing* systems, complex forms of experience emerge spontaneously. These systems are at the same time physical (non-experiential) and experiential, in other words they have experiences. As Strawson put it, "Once upon a time there was relatively unorganized matter with both experiential and non-experiential fundamental features. It organized into increasingly complex forms, both experiential and non-experiential, by many processes including evolution by natural selection."¹⁵ Unlike Searle's attempt to explain consciousness by saying that it emerges from totally unconscious, insentient matter, Strawson's proposal is that more complex form of experience emerge from less complex ones. There is a difference of degree, but not of kind.

The eminent American philosopher Thomas Nagel has put forward a powerful argument for panpsychism in his recent book *Mind and Cosmos: Why the Materialist Neo-Darwinian Conception of Nature is Almost Certainly False* (2012).¹⁷ He too frames it in an evolutionary context: "Each of our lives is a part of the lengthy process of the universe gradually waking up and becoming aware of itself."¹⁸

Panpsychism is not a new idea. Most people used to believe in it, and many still do. All over the world, traditional people saw the world around them as alive and in some sense conscious or aware: the planets, the stars, the earth, the plants, and the animals all had spirits or souls. Ancient Greek philosophy grew up in this context, although some of the earliest philosophers were hylozoists and rather than panpsychists, that is, they saw all things as in some degree alive, without necessarily supposing that they had sensations or experiences. In medieval Europe, philosophers and theologians took for granted that the world was full of animate beings. The plants and animals had souls, and the stars and planets were governed by intelligences. Today this attitude is usually rejected as "naive," or "primitive," or "superstitious." Searle described it as "absurd."¹⁹

In the United States, the pioneering psychologist William James (1842–1910) advocated a form of panpsychism in which individual minds and a hierarchy of lower- and higher-order minds constituted the reality of the cosmos.²⁰ The philosopher Charles Sanders Peirce (1839–1914) saw the physical and mental as different aspects of underlying reality: "All mind more or less partakes of the nature of matter... Viewing a thing from the outside... it appears as matter. Viewing it from the inside... it appears as consciousness."²¹

In France, the philosopher Henri Bergson (1859–1941) took this tradition of thought to a new level by emphasizing the

importance of memory. All physical events contain a memory of the past, which is what enables them to endure. The unconscious matter of mechanistic physics was assumed by Bergson's contemporaries to persist unchanged until acted on by external forces; matter lived in an eternal instant, and had no time within it. Bergson argued that mechanistic physics treated changes cinematographically, as if there were a series of static, frozen moments. But for Bergson, this kind of physics was an abstraction that left out the essential feature of living nature. "Duration is essentially a continuation of what no longer exists into what does exist. This is real time, perceived and lived... Duration therefore implies consciousness; and we place consciousness at the heart of things for the very reason that we credit them with a time that endures."²²

The leading panpsychist philosopher in the English-speaking world was Alfred North Whitehead (1861–1947), who started his career as a mathematician at Trinity College, Cambridge, where he taught Bertrand Russell. Together they co-authored *Principia Mathematica* (1910–1913), one of the most important works in twentieth-century mathematical philosophy. Whitehead then developed a theory of relativity that made almost identical predictions to Einstein's, and both theories were confirmed by the same experiments.

Whitehead was probably the first philosopher to recognize the radical implications of quantum physics. He realized that the wave theory of matter destroyed the old idea of material bodies as essentially spatial, existing at points in time, but without any time within them. According to quantum physics, every primordial element of matter is "an organized system of vibratory streaming of energy."²³ A wave does not exist in an instant, it takes time; its waves connect the past and the future. He thought of the physical world as made up not of material objects but *actual entities* or *events*. An event is a happening or a becoming. It has time within it. It is a process, not a thing. As Whitehead put it, "An event in realizing itself displays a pattern." The pattern "requires a duration involving a definite lapse of time, and not merely an instantaneous moment."²³

As Whitehead made clear, physics itself was pointing to the conclusion that Bergson had already reached. There is no such thing as timeless matter. All physical objects are processes that have time within them, an inner duration. Quantum physics shows that there is a minimum time period for events, because everything is vibratory, and no vibration can be instantaneous. The fundamental units of nature, including photons and electrons, are temporal as well as spatial. There is no "nature at an instant."²⁴

Perhaps the most astonishing and original feature of Whitehead's theory was his new perspective on the relationship between mind and body as a relationship in time. The usual way of conceiving this relationship is spatial: your mind is inside your body, while the physical world is outside. Your mind sees things from within; it has an inner life. Even from the materialist point of view, the mind is literally "inside"—inside the brain, insulated within the darkness of the skull. The rest of the body and the entire external world are "outside."

By contrast, for Whitehead mind and matter are related as phases in a process. Time, not space, is the key to their relationship. Reality consists of moments in process, and one

moment informs the next. The distinction between moments requires the experiencer to feel the difference between the moment of now and past or future moments. Every actuality is a moment of experience. As it expires and becomes a past moment, it is succeeded by a new moment of “now,” a new subject of experience. Meanwhile the moment that has just expired becomes a past object for the new subject—and an object for other subjects too. Whitehead summed this up in the phrase, “Now subject, then object.”²⁵ Experience is always “now,” and matter is always “ago.” The link from the past to the present is physical causality, as in ordinary physics, and from the present to the past is feeling, or, to use Whitehead’s technical term, “prehension,” meaning, literally, seizing, or grasping.

According to Whitehead, every actual occasion is, therefore, both determined by physical causes from the past, and by the self-creative, self-renewing subject that both chooses its own past and chooses among its potential futures. Through its prehensions it selects what aspects of the past it brings into its own physical being in the present, and also chooses among the possibilities that determine its future. It is connected to its past by selective memories, and connected to its potential future through its choices. Even the smallest possible processes, like quantum events, are both physical and mental; they are oriented in time. The direction of physical causation is from the past to the present, but the direction of mental activity runs the other way, from the present into the past through prehensions, and from potential and futures into to the present. There is thus a time-polarity between the mental and physical poles of an event: physical causation from past to present, and mental causation from present to past.

Whitehead was not proposing that atoms are conscious in the same way that we are, but that they have experiences and feelings. Feelings, emotions, and experiences are more fundamental than human consciousness, and every mental event is informed and causally conditioned by material events, which are themselves composed of expired experiences. Knowing can happen only because the past streams into the present, forming it and shaping it, and at the same time the subject chooses among the possibilities that help determine its future.²⁵

Whitehead’s philosophy is notoriously difficult to follow, especially in his key book *Process and Reality* (1929), but his insights about the temporal relationship of mind and matter point to a way forward, and are well worth trying to understand, even if they are very abstract. One of his modern exponents, Christian de Quincey, has described his idea as follows:

Think of reality as made up of countless gazillions of ‘bubble moments’, where each bubble is both physical and mental—a bubble or quantum of *sentient energy*.... Each bubble exists for a moment and then *pops!* and the resulting ‘spray’ is the objective ‘stuff’ that composes the physical pole of the next momentary bubble... Time is our experience of the ongoing succession of these momentary bubbles of being (or bubbles of *becoming*) popping in and out of the present moment of *now*. We feel this succession of moments as the flow of the present slipping into the past, always replenished by new

moments of ‘now’ from an apparently inexhaustible source we objectify as the future... The future does not exist except as *potentials* or possibilities in the present moment—in experience—which is always conditioned by the objective pressure of the past (the physical world). Subjectivity (consciousness, awareness) is what-it-feels-like to experience these possibilities, and choosing from them to create the next new moment of experience.²⁶

CONSCIOUS AND UNCONSCIOUS MINDS

There are at least two senses of the word unconscious. One means totally devoid of mind, experience, and feeling, and this is what materialists mean when they say matter is unconscious. Physicists and chemists treat the systems they study as unconscious in this absolute sense. But a very different meaning of “unconscious” is implied by the phrase “unconscious mind.” Most of our own mental processes are unconscious, including most of our habits. When driving a car we can carry on a conversation while our perceptions of the road and other vehicles affect our responses, without our being consciously aware of all our movements and choices. When I come to a familiar road junction, I may turn right automatically, because this is my habitual route. I am choosing among possibilities, but choosing on the basis of habit. By contrast, if I am driving in an unfamiliar town and trying to find my way with the help of a map, my choice when I come to a junction depends on conscious deliberation. But only a small minority of our choices are conscious. Most of our behavior is habitual, and habits by their very nature work unconsciously.

Like humans, animals are largely creatures of habit. Yet the fact that they are not conscious of most of their actions—as we are not conscious of most of our own—does not mean they are mindless machines. They have a mental aspect as well as a physical aspect, and their mental aspect is shaped by their habits, feelings, and potentialities, among which they choose, unconsciously or consciously.

It may not make much sense to suggest that electrons, atoms, and molecules make conscious choices, but they may make unconscious choices on the basis of habits, just as we do and animals do. According to quantum theory, even elementary particles like electrons have many alternative future possibilities. The calculation of their behavior by physicists involves taking all their possible futures into account.²⁷ Electrons are physical in that they re-enact elements of their past; but they also have a mental pole in that they relate this re-enactment of the past to their future potentialities, which in some sense work backwards in time.

But can we meaningfully say that electrons have experiences, feelings and motivations? Can they be attracted towards one possible future, or repelled by another? The answer is “yes.” For a start, they are electrically charged; they “feel” the electric field around them; they are attracted towards positively charged bodies, and repelled by those with negative charges. Physicists model their behavior mathematically without supposing that that their feelings, attractions, and repulsions are anything other than physical forces, or that their individually unpredictable behavior is governed by anything other than chance and probability. Materialists

would say that only by fanciful metaphors can they be seen to have feelings or experience. But some physicists think differently, like David Bohm and Freeman Dyson. Bohm observed, "The question is whether matter is rather crude and mechanical or whether it gets more and more subtle and becomes indistinguishable from what people have called mind."²⁸ Freeman Dyson wrote,

I think our consciousness is not just a passive epiphenomenon carried along by the chemical events in our brains, but is an active agent forcing the molecular complexes to make choices between one quantum state and another. In other words, mind is already inherent in every electron, and the processes of human consciousness differ only in degree but not in kind from the processes of choice between quantum states which we call 'chance' when they are made by an electron.²⁹

These are difficult questions, and raise all sorts of questions about the meaning of words like "feeling," "experience," and "attraction." Are they metaphorical when applied to quantum systems? Perhaps. But we do not have a choice between metaphorical and non-metaphorical thinking. There are no metaphor-free zones in science. The whole of science is suffused with legal metaphors, as in "laws of nature," materialist theories of mind in computer metaphors, and so on. But the issues are not merely literary or rhetorical, but scientific. As Bergson and Whitehead made clear, the mental and physical aspects of material bodies have different relationships to time and to causation.

MINDS BEYOND BRAINS

If our minds are not just the activity of our brains, there is no need for them to be confined to the insides of our heads. As I argue in my book *Science Set Free*, our minds are extended in every act of perception, reaching even as far as the stars. Vision involves a two-way process: the inward movement of light into the eyes and the outward projection of images. What we see around us is in our minds but not in our brains. When we look at something, in a sense, our mind touches it. This may help to explain the sense of being stared at. Most people say they have felt when someone was looking at them from behind, and most people also claim to have made people turn round by looking at them. This ability to detect stares seems to be real, as shown in many scientific tests, and even seems to work through closed circuit television.

Minds are extended beyond brains not only in space but also in time, and connect us to our own pasts through memory and to virtual futures, among which we choose. As discussed in *Science Set Free*, repeated failures to find memory traces fit well with the idea of memory as a resonant phenomenon, where similar past patterns of activity in the past affect present activities in minds and brains. Individual and collective memory both depend on resonance, but self-resonance from an individual's own past is more specific and hence more effective. Animal and human learning may be transmitted by morphic resonance across space and time. The resonance theory helps account for the ability of memories to survive serious damage to brains, and is consistent with all-known kinds of remembering. This theory predicts that if animals, say

rats, learn a new trick in one place, say Harvard, rats all over the world should be able to learn it faster thereafter. There is already evidence that this actually happens. Similar principles apply to human learning. For example, if millions of people do standard tests, like IQ tests, they should become progressively easier, on average, for other people to do. Again, this seems to be what happens. Individual memory and collective memory are different aspects of the same phenomenon and differ in degree, not in kind.

And if minds are not confined to brains in space or in time, it becomes much easier to understand how psychic phenomena like telepathy might fit into an expanded, post-materialist science. Here I have space only to summarize my conclusions from an extended discussion in *Science Set Free*.

Most people claim to have had telepathic experiences. Numerous statistical experiments have shown that information can be transmitted from person to person in a way that cannot be explained in terms of the normal senses. Telepathy typically happens between people who are closely bonded, like mothers and children, spouses and close friends. Many nursing mothers seem to be able to detect when their babies are in distress when they are miles away. The commonest kind of telepathy in the modern world occurs in connection with telephone calls when people think of someone who then rings, or who just know who is calling. Numerous experimental tests have shown that this is a real phenomenon. It does not fall off with distance. Social animals seem to be able to keep in touch with members of their group at a distance telepathically, and domesticated animals like dogs, cats, horses, and parrots often pick up their owners' emotions and intentions at a distance as shown in experiments with dogs and parrots.

Other psychic abilities include premonitions and precognitions, as shown by their anticipation of earthquakes, tsunamis, and other disasters by many species of animals. Human premonitions usually occur in dreams or through intuitions. In experimental research on human presentiments, future emotional events seem able to work "backwards" in time to produce detectable physiological effects.

SCIENTIFIC FUTURES

The sciences are entering a new phase. The materialist ideology that has ruled them since the 19th century is out of date. All 10 of its essential doctrines have been superseded.

The sciences will have to change for another reason too: they are now global. Mechanistic science and the materialist ideology grew up in Europe, and were strongly influenced by the religious disputes that obsessed Europeans from the 17th century onwards. But these preoccupations are alien to cultures and traditions in many other parts of the world.

In 2011, the worldwide expenditure on scientific and technological research and development was more than \$1000 billion, of which China spent \$100 billion.³⁰ Asian countries, especially China and India, now produce enormous numbers of science and engineering graduates. In 2007, at the B.Sc. level there were 2,500,000 science and engineering graduates in India and 1,500,000 in China³¹ compared with 515,000 in the US.³² In addition, many of those studying in the US and Europe are from other countries: in 2007, nearly a

third of the graduate students in science and engineering in the US were foreign, with the majority from India, China, and Korea.³³

Yet the sciences as taught in Asia, Africa, the Islamic countries, and elsewhere are still packaged in an ideology shaped by their European past. Materialism gains its persuasive power from the technological applications of science. But the successes of these applications do not prove that this ideology is true. Penicillin will go on killing bacteria, jet planes will keep on flying, and mobile telephones will still work if scientists move on to wider views of nature.

No one can foresee how the sciences will evolve, but I believe recognizing that “science” is not one thing will facilitate their development. “Science” has given way to the sciences. By moving beyond physicalism, the status of physics has changed. By freeing the sciences from the ideology of materialism, new opportunities for debate and dialog open up, and so do new possibilities for research.

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