David E. H. Jones

Why Are We Conscious?

A Scientist's Take on Consciousness and Extrasensory Perception

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Contents

Conventions

In this book I condense numbers big and small by means of the 'exponential notation' universal in science. Thus 10^y means '1.0 with the decimal place moved y places to the right' or more simply '1 followed by y noughts'. 10^0 is just 1. 10^{-y} means '1 divided by 10^y, or '1.0 with the decimal point moved y places to the left'. Some scientific numbers are 'pure' (such as the pure number Greek 'pi'; π is 3.14159… but never terminates), but most have a 'dimension'. These are usually made up of 3 common units, the metre (m, slightly more than a yard), the kilogram (kg, about 2.2 pounds) and the second (s), the common unit of time. I put a space between a number and its unit or dimension (e.g. a length of one metre is 1 m). A calculation in MKS dimensions gives its result in MKS. Conveniently, this is generally in the accepted MKS units for that result.

A few further examples may help. Thus the unit of area, a square meter in the MKS system, has the dimension m^2. Where a unit has more than one type of dimension, I join them by a dot or dots. Thus the unit of velocity, metres per second, has the total dimension $m{\cdot}s^{-1}$. The speed of light, c, is very nearly 3.00×10^8 $m{\cdot}s^{-1}$. A non-MKS unit is sometimes more readily comprehensible: thus a big volume is often more understandable as so many cubic kilometers. To use such a volume in a calculation, however, we have to convert it back to MKS units. This is usually easy: in this case 1 km = 10^3 m, so 1 km^3 = 10^9 m^3.

I often refer to very big numbers. A million is 10^6; a billion is 10^9; a trillion is a million million, or 10^{12}. I also often refer to temperature. The Earth is warm—a typical atmospheric temperature might be 290 K, where K is 'degrees Kelvin' or 'degrees Absolute'. Water freezes to ice at nearly 273 K. Absolute zero, which is as cold as you can ever get, is 0 K. The cosmic microwave background which permeates the whole universe, is at about 3 K.

1

The Human Experience

We live in two worlds. The first and most obvious is the public world we all know. It contains the earth with its objects and animals, and the atmosphere and the heavens. We can generally agree on the things in it. In recent centuries a public science of this world has grown up. Anyone can make an observation, perform an experiment, set out a chain of reasoning, and publish the finding for others to examine or challenge. Many events in the physical world are repeatable and publishable; even those which are essentially unpredictable (e.g. nuclear decay in a radioactive atom) often obey publishable statistical laws. Such publications are typically made by specialized scientists, and few people deny the scientific view of the physical world that they have built up.

The second world is private, and inside our own head. Each of us is born, typically lives for a few decades, and then dies. In that time, each of us has private experiences, such as communicating with other beings or adopting a religious faith. Crucially, we are conscious: indeed, this is

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the only thing we directly know. We do not merely react to our surroundings; we are aware of them. This private world may sometimes include very odd single experiences which seem neither predictable nor subject to statistical analysis. Examples include the sudden awarenesses of telepathy, and the sudden birth of a new idea.

The two worlds seldom talk with each other. Indeed, many of those who support the public, scientific sense of the world dismiss the private world as full of nonsense. Numerous strange 'paranormal' or 'psychic' half-beliefs belong there, as do spirits, ghosts, angels, devils and religious beings in general. Many skeptical physical scientists simply discard the whole lot of them as so much hallucination and superstition. This is the dismissive attitude adopted by CSICOP (the Committee for Scientific Investigation of Claims of the Paranormal, later shortened to CSI, the Committee for Skeptical Inquiry).

This book, however, attempts to see whether the two worlds can be combined, at least partly. I have spent most of my working life as a physical scientist, in fact as a chemist, extending that public scientific world. Yet I have grown to respect the private mental world. Where the two worlds collide, science is often feeble and unsatisfying. It has nothing to say about the way that everyone is conscious and self-aware, and that many people see ghosts, communicate with spiritual entities, have psychic experiences, believe in a life before birth or after death, and so on. I feel that it worth imagining what extensions to existing physical science might have to be made for some of these notions to become acceptable. I have mused before on the way we all have an 'unconscious mind', which occasionally pushes stuff 'upstairs' to the conscious mind (Jones[21]). The process often includes a massive distortion, which helps to explain why many 'paranormal' experiences seem not to make sense. I suspect that the unconscious mind sometimes makes contact with an unknown world 'outside our diving bell', a phrase which I use many times in this book. It was originated by the luckless Monsieur Bauby (Bauby[3] and below). That unknown world may contain much information never accessed by physical science. I am reminded that Shakespeare was unsatisfied by many philosophies. In *Hamlet* he denounces Horatio: 'There are more things in heaven and earth, Horatio, than are dreamt of in your philosophy.' Sadly, Horatio never gave his philosophy, but I present a possible one here.

Existing physical science contains several huge puzzles. One of them is consciousness. There is no theory of it at all: physical science says that everything is made of atoms, and nothing made of atoms should be conscious. Charles Sherrington said of consciousness, 'The problem remains where Aristotle left it 2000 years ago'; the philosopher Descartes recognized it but failed to solve it (Chapter 3); the modern philosopher David Chalmers calls it 'the hard problem'—which it is. There is not even a test for consciousness—thus the question 'Is a beetle conscious?' cannot be answered. One simple but trivial way out would simply be to add consciousness to the set of material properties accepted by physical science: length, mass, electric charge and so on. This simply puts the puzzle in a new form: why, among all material objects, do only human beings and some species of higher animal seem to be conscious? This book does not solve the problem, but adds a new notion. I claim that for an object to be conscious, it needs an unconscious mind. This fits the biological suggestion that the higher animals, as well as human beings, have unconscious minds. The unconscious mind was invented and developed almost entirely by psychiatrists, but we all become aware of it when we get a new idea that 'suddenly just pops up' from it (Jones[21]). The unconscious mind is, in my view, one of the most important hypotheses of the 1900s. I suspect that the strong form of artificial intelligence, which claims that a computer might be conscious, has so far failed because nobody has made a computer with an unconscious mind, or has even thought of how to do it. Indeed, consciousness may be the biggest unsolved problem we know about. It seems to occur in the human brain, and in the brains of higher animals; yet brain physiologists have looked in vain for any details that might help them. I glance at some of the technical problems in Chapter 16.

In this book, I explore the idea that the unconscious mind somehow makes contact with an unknown world 'outside our diving bell'. Almost all of us have absorbed the idea that the observable world is not all that there is. Radio, TV, and much computer technology exploits an 'electromagnetic world' which we cannot feel, but which carries information for us. My proposed additional 'unknown world' also fills space and carries information. It may be as physical and simple as the electromagnetic world, but may also have unique properties. Chapter 7 explores the properties it must have to fit into the physical scientific world we know about. If it exists, and occupies the same space as the physical world, it is only weakly coupled to it. In Chapters 16 and 17 I guess at the sort of technical advances which might allow it to be found and, maybe, explored instrumentally—thus it might be observed by a major development in artificial intelligence! My guess is that this world 'outside our diving bell' is the source of the information which is sometimes picked up by the unconscious mind. It may also have inhabitants (like the physical world). Current science has not looked for it, nor stumbled over aspects of it experimentally. This is not surprising: existing scientific instruments have almost all been invented and developed to study the physical world. I surmise that that 'unknown world outside our diving bell' exists and is often partly accessible to the unconscious mind. It may be detectable by novel scientific experiments. My musings here are not unusual. Several other scientists have also sought to explain physical puzzles by proposing unobserved entities and even unobserved universes (I mention Hugh Everett III and his 'many worlds' theory of quantum mechanics in Appendix D). Much of my observational evidence (largely presented in Chapters 8 to 11) comes from the somewhat disreputable field of 'parapsychology'. I need what it can give me, even though it often makes me as a physical scientist feel rather grubby. For the most part it consists of honest human reports; it would be scientific cowardice to ignore them, even when they do not seem to make sense to me.

The sad story of Monsieur Jean-Dominique Bauby concerns the terrible fate he suffered in 1995. A major stroke deprived him of almost all bodily movement. He could only move his left eye. He managed to write a book about his fate—by blinking that eye to a set of alphabetic cards held up by a publisher's assistant. *The Diving Bell and the Butterfly*[3] was a literary account of his tragedy. It invited the reader to imagine a butterfly trapped inside a diving bell. It was very successful, and was even made into a film.

My suspicion is that intellectually, we are in the same sort of predicament today. We know a great deal about the physical world, and scientific observations are steadily telling us more. On the other hand, we know essentially nothing about the possible world outside our physical diving bell. Many scientists deny that there is anything outside it. In Victorian times our understanding of the physical world was so good that physics was thought to be essentially complete. Numerous people these days have the same sort of sense. This book disputes such a view; I reckon we know very little about anything that matters.

One of my reasons is entirely social. Religious views of the world seem emotionally very strong. It impresses me that when a materialist political system collapses (and I am thinking here of the Soviet Union in the 1990s) a lot of popular religious feeling resurfaces. I suspect it was there all the time. The current materialistic Chinese dictatorship fights a steady battle against religious cults. It successfully opposed the Falung Gong religious movement. It dispatched many adherents to labour camps and psychiatric wards to ‘cure’ their sectarian obsession. But despite such authoritarian antagonism, cults continue to appeal.

In some way we would all like a comforting religious creed to believe in. Few human minds are satisfied by a scientific and materialistic view of the world, and many people yearn for something beyond it. As a result, many strange beliefs survive, not in the public scientific world, but in the private mental one. This book tries to rescue some of them by a guessed extension of physical science. I sketch our current understanding of the physical world in Chapters 2 and 3, and go on to explore some of the issues raised by that possible unknown world. Thus this book starts fairly conventionally, but goes on to be more speculative.

2

The Physical World

THE PHYSICAL WORLD CONTAINS MANY things which scientists have discovered. A book by the two Morrisons, *Powers of Ten*,[29] gives an informative sketch. Here I outline a few scientific findings.

What is the physical world made of?

At present, we reckon that the whole physical world is made of fundamental particles. There are many different kinds (as the physicist Enrico Fermi said, 'If I knew the names of all these particles, I'd be a botanist'). Most are transient, and are seen only in violent particle-collisions. Some may exist as 'exchange particles' holding others together. One worrying claim is that the universe is largely made up of strange stuff called 'dark matter'; it may be particulate, but we know nothing about it. Here I propose to ignore dark matter, and regard the whole universe as being made up of atoms. They consist of three kinds of stable and enduring particle: the proton, the neutron and

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the electron. The proton carries a single positive electric charge of a bit more than 10^{-19} coulombs. The neutron has about the same size and mass as the proton, but is neutral. The electron is about 10^{-30} kg in weight, and is thus much lighter than the other two. It has a negative electric charge equal and opposite to the positive one of the proton. Everything we know about is made up of these three particles, which combine as atoms.

Each atom has a tiny central 'nucleus' which is a tiny assembly of protons and neutrons, like 'a fly in a cathedral'. It accounts for almost all the weight of the atom, but almost none of its size. Around the tiny nucleus fly orbiting electrons, enough to make the atom as a whole electrically neutral. Appendix C discusses the strange quantum-mechanical laws which seem to govern them; it makes sense to regard the electrons as shells of wavelike 'electron density'. Accordingly, an atom does not have a sharp edge; it just fades away. The best we can do is to say that it is about 10^{-10} m across. One atom can combine chemically with another; the two can form a clump or diatomic molecule by an interaction of their outer electron-shells. Further atoms can then add to the clump; many different sorts of such multi-atom 'chemical molecules' are known. Each forms a specific material, such as salt or water. A living object (a virus or a cell, say) is a little structure assembled from many chemical materials. Each part of such a structure probably contains trillions of chemical molecules.

Some atomic nuclei are 'radioactive', i.e. unstable. They last for a while (which can be under a microsecond or over a million years), but ultimately decay unpredictably, releasing energy. The Earth is hot inside, because of present and past radioactive decays within it. This unpredictable decay is, quantum mechanically, an 'uncaused event'. Schmidt[32] has shown that radioactive decay can be predicted a little better than chance by a few rare and gifted people—this is part of the evidence for my feeling that that there is an unknown world outside the diving bell we know about (Chapter 8).

There are a few hundred stable non-radioactive atomic nuclei. Made into atoms by the electron density around them, and often combined further into chemical substances, they make up the whole material world we know about. It is a common claim that the universe is largely made up, not of atomic matter at all, but of 'dark matter' and 'dark energy'. This book, however, takes all matter to be atomic.

Astronomy

Atoms are very small compared to common material objects. Thus there are about 10^{28} atoms in a man. The Earth is made of many more atoms (about 10^{50}) and the Sun of even more (about 10^{60}). The Sun is so hot that astronomers reckon that most of its atoms are almost permanently torn apart by the intensity of its energy. It consists of atomic nuclei surrounded by a swirling mass of electron density, with no nucleus able to hold onto its electrons for any length of time. Nonetheless, the Sun is electrically neutral, and it makes sense to talk of its composition. It is mainly hydrogen and helium, with small amounts of heavier elements. In the hot Sun these are essentially just atomic nuclei surrounded by a twirl of electrons, but if you could extract a bit of Sun-stuff and cool it down, atoms should condense out of it. The Sun is hot because the atomic nuclei in it occasionally collide, and react to heavier elements. Such nuclear reactions generally give out a vast amount of energy. This usually gives the product particles a very high velocity—i.e. makes them extremely hot. Our own current energy crisis has stimulated attempts to imitate the process on Earth.

The Earth is one of 10 planets that go round the Sun in the solar system. Each is kept in its orbit by the pull of gravity. The Earth is about 1.5×10^{11} m from the Sun, and goes round it in an almost circular orbit once a year. The Sun seems a typical star, 1.4×10^{9} m across, but we do not know if planets are a common feature of stars. Our galaxy consists of a cluster of a few hundred billion stars. They are very widely spread: each is about 10^{17} m from its nearest neighbour, perhaps 10^{9} stellar diameters. The galaxy as a whole (whose edge we see in the sky as the Milky Way) is about 10^{21} m across, and has a volume of about 10^{63} m^3. Between its stars is an 'interstellar gas', which in this book I take to be mainly hydrogen atoms, say a million per m^3. Thus it is much more tenuous than a good earthly vacuum (ordinary air contains over 10^{25} molecules per m^3. It is mainly molecular doublets of nitrogen atoms and oxygen atoms.) Interstellar material sometimes also includes highly dilute chemical molecules, and highly dilute dust.

Our galaxy of a few hundred billion stars is not alone. It is one of many. Like ours, each is a cluster of stars, and there are many types. Ours seems to be a spiral galaxy, of which there are lots of other examples. The visible universe has about 10^{11} galaxies, each about 4×10^{22} m from its neighbours. They tend not to be spread evenly, but to be clustered. The space between them seems to be an almost completely empty vacuum. Intergalactic space has, perhaps, only about 100 hydrogen atoms in every cubic metre, much less than the interstellar gas within a galaxy. The galaxies seem to be receding from us, and from each other (this is 'the expansion of the universe'). The rate of expansion is defined by the Hubble constant, for which a good modern value may be about 1 $m{\cdot}s^{-1}$ per 4.2×10^{17} m of distance. Accordingly galaxies more than about 10^{26} m away from us are receding faster than the speed of light, and we can never observe them. Furthermore, in looking far into space we are also looking back in time; the finite speed of light means that we see things not as they are, but as they were when the light was emitted. The furthest objects we can hope to see will have generated that light just after the universe became transparent. This also limits our vision to about 10^{26} m. Accordingly, the volume of space that we are concerned with is a mere 10^{79} m^3, or 10^{70} km^3.

At least one big question remains: what is the whole thing for? Some cosmologists support the Anthropic Principle, in which the entire structure, and the laws which underlie it, exist to make intelligent life possible. I discuss it briefly and unsympathetically in Appendix E.

Many cosmologists also discard the Principle, and have compared it to the trivial proposition that the whole universe was created to produce some other rare phenomenon. Instead of intelligent life, they say, how about ferromagnetism or radioactivity? It distresses me, and many others, that the arrangement revealed by modern science does not seem to have any sort of design or purpose. As the physical theorist Steven Weinberg once said, 'The more the universe seems comprehensible, the more it also seems pointless.' As human beings, we all have a desire for some believable world-story. The old religious ones described the earth as all there was. Heaven was above it and hell beneath it, and God and the Devil played out a drama for the souls of the earthly humans. This was an exciting story; the Anthropic Principle does not, I fear, make a good emotional substitute.

The universe we observe may be only one of many (Appendix C). Accordingly, the notion of an unknown world 'outside our diving bell', with which the human unconscious mind seems able occasionally to make contact, seems worth exploring. In Chapters 16 and 17 I muse on the experimental advances which might lead to a physical instrument that could also do it.

The electromagnetic spectrum

Apart from matter, what else do we find in the physical universe? One of the answers is radiation. The whole saga of the electromagnetic spectrum started with a tiny chunk of it, the visible light seen by our eyes. The eye is our chief sensory organ, and its mighty extensions the telescope, the microscope and the camera have dominated the building of our scientific picture of the world. It was the great Newton who showed that visible light consists of a few colours, from red to violet (summed they make white). Newton did not know that visible light is itself a tiny region of a huge range of radiations. But since his time later scientists have extended visible light into a whole new vast spectrum. Our imperfect mastery of that spectrum is almost a new sense in itself. A good way of classifying those radiations is by frequency. Right down at the low frequencies we have current electricity, which goes better through metal wires than through space. It ranges from the zero frequency d.c. made by batteries, the 50 or so cycles a second of the a.c. that generating stations deliver to our buildings, and the few kilocycles a second handled by sound amplifiers and loudspeakers. Frequencies greater than zero can travel through space. Thus we find radio waves from a few kilocycles a second to many megacycles a second. At higher frequencies we have microwaves, infrared radiation and (at a few hundred trillion cycles a second) visible light. At even higher frequencies come ultraviolet light, X-rays, and gamma rays.

Generally speaking, our technical skill with this spectrum decreases with frequency. At the low end, we can make electricity more or less to order and can accomplish a vast amount with it (the portable electric meters by which we measure voltage, current, frequency, electrical resistance and so on, are practically new senses in themselves). Our skill in generating specific frequencies, and measuring and using them, extends through much of radio, but begins to falter in the microwave region. With infrared radiation, visible light and higher frequencies, we can usually measure a given frequency but have trouble generating it. The goodness of Mother Nature lets us generate a few specific sharp wavelengths (in masers and lasers), but we usually cannot tune around them to play with other wavelengths and frequencies nearby. Astronomy depends on detecting radiation from the sky very sensitively. It has done wonders with visible light, and radio astronomy is advancing rapidly. But much may still remain to be revealed about the universe in the infrared and ultraviolet bands, and even more when we are able to detect and make images from specific frequencies of light and other optical radiations. However, at present our photographic film and photosensitive diodes respond to quite broad ranges of radiation.

Quantum mechanics complicates our understanding of radiation. Newton thought it was a stream of particles, Victorian physicists thought it was waves; quantum mechanics asserts that it is both. Modern physicists reckon that all radiation consists of 'photons', which are particles with a wavelength, but no inherent mass. They all travel through space at the same velocity, that of light—nearly $3.00 \times 10^{8}\ \mathrm{m \cdot s^{-1}}$. (This view fits the theory of quantum mechanics, which I discuss in Appendix C.)

The creation and duration of the universe

Both matter and radiation exist in physical space. The idea once seemed simple: scientists and engineers assumed that there are three dimensions of space, through which we can move freely, and one dimension of time, through which we move steadily and unalterably. (I recall Kipling's powerful phrase, 'the unforgiving minute'.) Recently, scientific space has got more complicated. Fred Hoyle's theory of 'continuous creation' had hydrogen atoms appearing spontaneously in it. There is also a theory that particle-antiparticle pairs can appear briefly in it; this plays a part in the theory of black holes. Some theoretical physicists want more spatial dimensions; I discuss dimensionality in Chapter 7. Nobody seems to have complicated time this way.

Both space and time seem to be infinite, in the sense that you cannot easily imagine an 'edge' to either. When I worked for the Yorkshire Television Company on the science show *Don't Ask Me*, we often got the question from viewers 'Where does space end?'. Since this cannot be answered at all, and certainly not by an entertaining demonstration in a television studio, we ignored it. Time is equally puzzling. The physical laws as we understand them work both forwards and backwards in time; the only one which appears to define a time direction is the second law of thermodynamics. It asserts that entropy (a measure of randomness) always increases, so that the temperature differences of the world (a mark of non-randomness) must on average always decrease. This implies that the universe began with an extremely small entropy. Theories exist in which both space and time are closed but circular, so that (like the surface of the Earth) you never come to an edge but there is only a certain amount of them. Such ideas have an appeal, but they do not amount to a theory. If space is indeed curved enough to close up on itself, a powerful enough telescope would show you the back of your own head.

Space is strange stuff. It exists to hold material—that is why the notion was invented. But it has other abilities too. The fact that light can be transmitted through it used to worry physicists. They invented a 'luminiferous ether' filling all space, through which light could travel (as sound does through air). Then the great physicist James Maxwell considered the strange fact that electric fields and magnetic fields can go through space as well, seemingly without an ether to transmit them (although some physicists invented ethers for these too). He showed that electric and magnetic forces should generate 'electromagnetic radiation', and calculated that it travelled at the speed of light. Physicists soon decided that light was simply Maxwell's theoretical electromagnetic radiation and began to explore other regions of the electromagnetic spectrum.

Space does not merely hold matter and transmit radiation. It transmits forces, usually classified as 'fields', such as those of electricity, magnetism, and gravity. This is a form of 'action at a distance'. Newton accepted it but declined to propose any hypothesis to account for it. Faraday not only accepted it, he invented the 'lines of force' by which the force exerted by a field at any distance can be assessed and calculated. Physicists nowadays tend to dislike it and avoid it. Thus of the four forces whose explanation previously required fields acting at a distance, three are now felt to work by the exchange of particles. Thus, roughly speaking, the strong nuclear force is now thought to be caused through an exchange of gluons; the weak nuclear force is due to the exchange of bosons; the electric and magnetic forces occur by the exchange of photons. Gravity is still an exception, and does not fit this picture. A particle, the 'graviton' has been invented for it, but nobody has seen one or devised an experiment to support its existence. Einstein explained gravity as due to the bending of space-time. If gravity could also be explained by particle exchange, the proposed Theory of Everything would come a step closer.

The scale of space and time

A very powerful modern question, an important advance over the questions asked by the ancient Greek philosophers, concerns time. How old is our universe? And how did it come about? Before about 1600, most writers reckoned that the world has always been much as we see it now. It consisted mainly of the Earth, and was created only a few thousand years ago. In the 1700s, geologists began to challenge this view. They took the present Earth as the result of many changes over time (for example, alterations of sea level). Their theories implied a lot of past time. The Darwinian evolution of life, first promulgated in 1859, took the bold step of applying this philosophy to the origin of plant and animal species. Evolution required many millions of years. Modern cosmology applies it to the whole universe, and requires even more time. One of the questions it asks is, How did the present structure of galaxies and stars arise? The current theory is that it all started with the Big Bang. One of the key pieces of evidence for this is the weak ‘cosmic microwave background’ which seems to fill all space. It was discovered accidentally in the 1960s, by workers at the Bell Telephone Company who were investigating the sky microwave background against which a communication satellite would have to operate. Russian scientists have called this background ‘relic radiation’. They argue that the Big Bang created a huge blast of radiation, and the subsequent expansion of the universe has greatly lengthened its wavelength. The recession of the galaxies lets us date the Big Bang roughly by calculating the time when that expansion began. It comes out as about 13 billion years ago. Similarly, our feelings for the future must now extend into a comparable temporal remoteness.

Nobody has any good theory of how or why creation happened. Current physical theory allows a vacuum to