*Doubt thou the stars are fire;*

# Conscious Mind in the Physical World

*Doubt that the sun doth move;*
*Doubt truth to be a liar;*

*But never doubt I love*

*radio VHF micro-wave infrared visible*

*up strange charmed quarks*

$|\Psi\rangle = \alpha\,|up, Me\rangle + \beta\,|down, Me\rangle$

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*René Descartes, who was the first "modern" thinker really to appreciate the problem which lies at the heart of this book, and whose influence, for better or worse, has pervaded the subject for over three hundred years, once wrote that a beautiful woman, a good book and a perfect preacher were the things most impossible to discover in the world. I doubt very much whether he would regard this as a good book, although he would certainly be amazed by what he discovered in it, and would, I believe, approve of its aims. I have not been able to resist the temptation to include what he would surely consider to be a very imperfect sermon, and I dedicate the book to Eileen.*

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# Contents

# Chapter 1

# Introduction

## 1.1 The book

This book is concerned with what is surely the most obvious and yet the most mysterious, and hence the most fascinating, of all phenomena: the conscious mind. The emphasis here is on the word "conscious"; we are not primarily concerned with the mechanical working of the brain, i.e. how it receives, stores and processes information, or with how such working can be modelled on a computer, interesting though such topics are, and in spite of their more obvious relation to physics. Our concern is with consciousness itself; not, for example, with the way an image is formed on my retina and then transmitted to my brain, but with the fact that I am aware of the sensation of seeing.

An attempt will be made to discuss consciousness within the context, and using the methods, of physics, or, more precisely, theoretical physics. Indeed much of the book is simply an account of some features of modern physics. Given the background of the author, as explained in the next section, this is perhaps inevitable, but it raises two immediate questions. One is whether conscious mind is within the domain of physics, i.e. should physicists, as physicists, be interested in the subject, and the other is whether physics has anything useful to contribute. Attempts to provide at least partial answers to these questions will be found in the following chapter.

Although the issues with which this book is concerned are extremely deep, profound and difficult, the basic questions can be presented, at least initially, in reasonably simple terms. The difficulties come when we try to make the questions more precise; still

more when we try to answer them! I have therefore tried to keep the discussion at an elementary and introductory level. There are a few mathematical equations in the text, but I hope readers who are unhappy with such things will be able to ignore them, and still follow the argument. In the more "philosophical" parts I have had no difficulty in avoiding technicalities (I would be incapable of understanding them). Some readers may feel that I have oversimplified the issues. Undoubtedly the work of many people, published in thousands of pages, has been reduced to a few words, and almost every chapter could have been expanded to make a complete book. In my defence I can refer to a desire to keep the discussion brief, to a general feeling that some philosophical discussions have a length that is disproportionate to their content and (since the last remark is too provocative) to my lack of experience in the subject, which means that it would be presumptuous of me to attempt anything other than an introduction.

The chapters in this book are intended to follow each other in a logical sequence. I have tried, however, to make each chapter reasonably self-contained, even at the cost of some repetition. I hope this will make the book easier to read, and will allow a certain amount of reader-selection in the order of chapters.

Very little in this book is claimed to be original. Essentially all of it has surely, in some form or another, been written elsewhere. Certainly the basic questions have been discussed, in various guises, since thinking man evolved. Of course the context has changed, and one of the purposes of this book is to study the questions in the light of our modern understanding of the physical world. It is a fact, still not properly appreciated by many scientists and philosophers, that quantum phenomena have revolutionised our view of that world. This revolution should not be ignored in any serious discussion of conscious mind. I have included some details of recent developments in the continuing endeavour of trying to interpret quantum theory, particularly as these are not widely known. In particular, I have tried to show how one model, closely related to the so-called *many-worlds* interpretation, might suggest answers to at least some of the problems regarding consciousness. These answers could have significance for topics that go far beyond the "merely philosophical". The last chapter is an attempt to provide a few conclusions, and is entirely a personal view.

*For whom is this book written?*

This is the question publishers always ask (rightly so) and authors tend to ignore. (It is easier to write the book we want to write, rather than the one somebody might want to read!) There are three principle groups to whom I hope it might be of interest. Firstly, there are psychologists, neuroscientists and, in particular, philosophers, who, in different ways, have a professional interest in the study of the mind and who, I believe, should know something about physics. A quick survey of the many books on the topic of the mind in the library here in Durham shows that this view is not generally held. It is clear that most authors consider physics to be irrelevant. Quantum theory is not mentioned until p.537 of the excellent and detailed study given by Gregory (1981) in *Mind in Science*, and then only in a very cursory way; it is essentially ignored in *The "Mental" and the "Physical"* (Feigl, 1967) and in *The Philosophy of Mind* (Smith and Jones, 1986); and it does not even appear in the index of *Matter and Consciousness* (Churchland, 1984), where I read: *The phenomena to be penetrated are now the common focus of a variety of related fields. Philosophy has been joined by psychology, artificial intelligence, neuroscience, ethology, and evolutionary theory, to name the principals.* There is no mention of physics. These, and many others, are excellent books, and readers will find in them much more detailed discussion of the issues raised in chapter 5, for example, but their lack of interest in physics is strange. How is it possible to argue about materialism, without some words about the nature of "matter", or about physicalism, unless there is some agreement about what "physics" actually is? As we shall see, these things are not trivial.

Much of this book is concerned to explain those aspects of physics, in particular quantum physics, which might be relevant to the mind. Most physics text-books are, quite properly, concerned with other aspects and applications of their subject, and are not ideal for this purpose. In consequence, physics is sometimes considered to be too daunting, or, what is worse, knowledge is acquired from unreliable sources. At the risk of again being provocative, I can quote as examples the reluctance of Popper and others to appreciate the implications of interference in quantum theory; the obsession that is sometimes seen with regard to the uncertainty principle, which is more properly regarded as a trivial

consequence of the theory than as a fundamental principle; the failure to recognise that the most significant revolution brought about by quantum theory is *not* the breakdown of causality; and, lastly, what seems to me the total misunderstanding of the subject found in books like *How the Laws of Physics Lie* (Cartwright, 1983).

Secondly, I hope that physicists will be interested. They will not learn anything new about how to calculate things in physics, but many will find the discussion of quantum theory goes beyond what they have learned from text-books and lectures, and I hope they will be fascinated by a topic that ultimately is too important to be left to philosophers. Their problems are often different to ours.

Finally, there is a large group who would not claim to be experts in any of the above subjects, but who are interested in what is known of the conscious mind, and, in particular, in whether it can be regarded as part of the physical world, or whether it inevitably requires something that is beyond physics. These are the issues which we shall continually be meeting.

## 1.2 The author

Since our only direct experience of a conscious mind is of our own consciousness, there is perhaps more excuse here than in most books for the author to say a little about himself.

Many years ago at the University of Manchester, I trained as a theoretical physicist. The head of the department was Leon Rosenfeld, who was extremely interested in the philosophy of science and who even lectured on it to his students. Unfortunately, I understood very little, and so, apart from the fact that he was an admirer of the Greek philosopher Epicurus, born in Samos in 341 BC, the only thing I remember is that he gave us what I now believe to be a mistaken idea that the problems of quantum theory had been solved by Niels Bohr. Although I am sure none of us comprehended the solution, we were afraid to admit it!

Since 1964 I have been professor of applied mathematics at the University of Durham. Here, apart from teaching students, I have endeavoured to do research into the theory of elementary particles. In practice this has largely meant endeavouring to keep up with the progress being made by other research workers, and, without

any doubt, I have been fortunate to live through a period of time when such progress has been both rapid and exciting.

To the obvious protest that the above background gives me no qualification to write about the subject of conscious mind, my immediate reaction is to say that so little is known about the subject that I am as well qualified as anyone. Of course the topic has been central to philosophy for at least two centuries, so my claim that little prior knowledge is required might be disputed. That I see little content in the work of so many clever people does not necessarily mean that more is not there. However, philosophers of science have also written extensively on a subject about which I do know something, namely, quantum theory, and it is clear that on this topic a lot of words has produced few things of significance. When philosophy has moved into physics, it has not made much progress—another provocative remark, and one which clearly invites a similar response to this book, in which a physicist is trying to move into philosophy!

I must also qualify the above statement that little is known on the subject of conscious mind, by mentioning the remarkable recent work of neuroscientists, some of which is discussed briefly in chapter 6. The problem here is to know whether the results really have any relevance to our topic. In any case, I am encouraged by the fact that John Eccles, who was awarded a Nobel Prize for neuroscience, recently wrote: *Unfortunately it is rare for a quantum physicist to risk an intrusion into the brain–mind problem* (Eccles, 1987, p.301). I take that to be an invitation, which I am glad to accept.

The third group of people who have professional interests related to conscious mind are psychologists. However, partly in a desire to be regarded as *serious* scientists, many psychologists try to avoid using the language of consciousness, and instead concentrate strictly on observation and description of behaviour (see section 5.4).

The idea of writing this book grew out of a previous semi-popular book on quantum theory (Squires, 1986), in which I was inevitably forced to write about consciousness, for reasons that will become clear in chapter 10. This led me to read about the subject, and the more I read, the more I became both fascinated and dissatisfied. Part of the reason for the latter feeling is presumably that what I read was not written by theoretical physicists, who

have provided most of my reading material for the past 30 years, and who have a way of writing and thinking about problems which is different to that of the world in general, perhaps even to that of most scientists, but which, given the success they have had, is surely of value. Of course many would argue that such a way of thinking is not appropriate to the topic of this book and, to some extent at least, they would be right.

In writing about conscious mind I am also aware that I am trying to do a little bridge-building. The cultural gulf between the scientific way of thinking, seen most clearly in the discipline of theoretical physics, and the way of thinking of all non-scientists, and indeed generally of scientists when they are not doing science, is vast. The basic assumptions, the accepted "paradigms" (an ugly word which I promise not to use again), are incompatible, or, perhaps it is truer to say, are so different that one set is meaningless to the other. I hope that at least some glimpses of "the other side" will be seen.

A final motivation is the desire we all have to answer the question: *Who am I?* I do not of course know the answer; if I did this would be a very different book. The most I can expect is that I might have clarified some of the questions. This last sentence may indicate another difference between the way physicists and philosophers write. In general I am not trying to propagate a particular position, or "ism". Indeed, as we shall see, I suspect that some of the strongly held views are not in fact so different to each other as their advocates apparently believe.

Just over 40 years ago one of the founders of quantum theory, E Schrödinger, prefaced a book entitled *What is Life?* (Schrödinger, 1944) with the words:

> *... we are only now beginning to acquire reliable material for welding together the sum total of all that is known into a whole; but, on the other hand, it has become next to impossible for a single mind fully to command more than a small specialised part of it. I can see no escape from this dilemma than that some of us should venture to embark on a synthesis of facts and theories, albeit with secondhand and incomplete knowledge of some of them—and at the risk of making fools of ourselves.*

The present book is written in a similar spirit.

# Chapter 2

# Physics and conscious mind

## 2.1 Physics as the theory of everything

In this section we ask whether conscious mind can properly be regarded as being in the domain of physics. Clearly we would answer such a question in the negative if we defined physics to be that which deals with the "physical", and then adopted the view that conscious mind is "non-physical". This answer would seem to require accepting already a so-called dualist position (see section 5.6), i.e. we would be separating the real world into two parts and designating one as belonging to physics.

Here, instead, and without at this stage wishing to prejudice the question of whether some sort of dualism is correct, we shall avoid making such an arbitrary restriction to what we call physics and take the positive view based on the fact that physics is generally regarded by those who study it as being (uniquely) **the** fundamental science. The prime task of fundamental physics is to understand the objects, laws, or whatever, that are the basis of *all* observed phenomena.

Later we shall discuss, and, I hope, be encouraged by, the enormous success that fundamental physics has had in such an endeavour. It is very impressive. The progress that has been made in this century is such that physicists sometimes dare to speak of a TOE, a "theory of everything". An honest assessment would say that such a TOE is, in reality, very far off (and in any case I am not sure that I am completely clear what the idea means), but at least it can be discussed. A characteristic of this is that, within a

group of contemporary physicists, there are no questions that are considered unreasonable; we can ask why space has three dimensions, why time has only one, why the charge on an electron has the value it has, why there are so many types of quark, why the galaxies are in clusters, etc. We may not be able to *answer* these questions, and it is probable that there are better questions that we have not even thought of, but at least there is the feeling that answers are possible.

However, even if we were able to find a theory which explained all observed phenomena, it would say nothing about the basic process of observation, i.e. the process through which there are any phenomena to be explained. *Everything* we know, we know by means of the conscious mind. A theory of everything would certainly explain why the light emitted from a particular transition of the sodium atom had a wavelength $5.89 \times 10^{-7}$ m, but I perceive this light as "yellow", and present physics does not contain such a concept.

What do we deduce from this? There have been many other times in the history of physics when the subject has suddenly been confronted with new phenomena. Electromagnetic waves, discussed in section 4.1, are a good example. However, in general, and usually in a short time, the new discoveries have been incorporated into an expanded version of physics. Should we expect that the same thing will happen with regard to consciousness? Will the properties of the conscious mind one day be included among the things which are discussed in physics text-books? Maybe the most reasonable guess is to answer no. But why?

It is important now to emphasise that we should not be seduced into accepting what, at least to the scientific community, might seem to be an easy way out. This runs roughly as follows (though it would never be explicitly stated in this form): physics is wonderfully successful in explaining the properties of the real world; physics does not contain anything about consciousness; hence consciousness is somehow less "real" than the things of physics. There is no logical basis for such an argument and it involves a rather arrogant view of our scientific attainments—*"what I don't understand isn't real"* is no more reasonable than *"what I don't know is not knowledge"* (attributed, as a joke, to the Master of Balliol College by H C Beeching)—but nevertheless it is necessary to be explicit in rejecting it.