Charles Birch, former Challis Professor of Biology at the University of Sydney, is one of the world’s leading ecologists and winner of the Templeton Prize for Religion in 1990. His early investigations on insects led to an interest in popular ecology. He went on to study genetics and ecology at the University of Chicago and at Oxford, and helped lay the foundations for the new science of population biology. His search for a philosophy that could embrace both science and religion culminated in what he calls ‘an ecological model of God’. He is 89 years old.
To Peter Farleigh
A loyal friend and constant inspiration in process thought.
SCIENCE
AND
Soul

CHARLES BIRCH

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FOREWORD

To a casual observer the conflict between religion and science is both entrenched and unresolvable. Starting from the church's suppression of Galileo, religion has led a five centuries' long assault on truth, which has left the world in the shambles we are in. At least that is what the current anti-religion campaign, led by celebrity scientist Richard Dawkins, would have us believe.

The truth is quite different. The early empiricists were profound believers in God, and on account of their faith were propelled – like the great Swedish botanist, Carl Linnaeus to observe and catalogue the natural order with all its competitive species and remarkable adaptations. Linnaeus, like so many early scientists, including the medical researcher and mystic, Paracelsus, and the intrepid metaphysician-cum-cosmologist and ex-monk, Giordano Bruno, believed that the world they studied inhered in God and was continuous with His creative will. To them were afforded brilliant intuitive insights about the nature of the world, such as its atomic structure and the infinity of the universe, of which we must stand in awe since their discernment of such subtle matters predated the advent of powerful microscopes and telescopes. Indeed, Isaac Newton, who wrote more on the Bible than he did on science and also gave us the Law of Gravity, is yet another demonstration of the co-existence of belief in God and a keen scientific mind.
These examples of the productive relationship between the scientific and the spiritual quest have not been consigned to the fossil record of the history of ideas, like some ill-fated species, unable to produce offspring. In our own era, Albert Einstein, usually ranked as the 20th century’s most important scientist, was not dissuaded of God’s existence with his discovery of the special theory of relativity, but confirmed in it. So it is in that venerable tradition that Charles Birch, Australia’s eminent ecologist and theologian, has urged a philosophical integration of spiritual and scientific ways of understanding life. It has not been a popular path to tread in an age when science and spirituality were generally considered irreconcilable opposites. With the help of some of the most eminent philosophers, theologians and scientists of the 20th century, this Melbourne-born biologist would develop a way of bringing these two ‘opposites’ together, and thereby climb the heights of what has become the holy mountain of the third millennium.

The idea that belief in God and a sophisticated understanding of the natural order, from evolutionary biology to the origins of the universe, should be possible and even integrated is a great intellectual challenge that faces the world. Not for Birch the quip by French biologist and Nobel Laureate Jacques Monod (1910–1976), that ‘the scientist who believes in God suffers from schizophrenia’. Birch’s entire body of work, from his early gem of a book, *Nature and God* (1965) to these late gleanings in the form of an intellectual memoir, demonstrates beyond a shadow of a doubt that Monod was wrong.

Of course, there are many ways to blend the scientific and the spiritual, and not all of them are recommended. We are currently seeing the popular notion of Intelligent Design, which posits a
God who not only created but fixed creation in its complexities of function and beauty. Many problems exist with that notion, including its fixity and the assumption that animals, flowers and human beings are designed for optimum functioning. It is a mechanical vision of nature and a belief in an interventionist God, which misses the depth of meaning that Birch discerns in existence. His meaning is born out of a relationship, in which God animates nature by persuasive love, elemental in all creation no matter how low it is on the evolutionary scale or how small its particles. By positing this relationship – of an interested God and a subjective nature (pansubjectivism) – Birch also makes a simple word or a feeling carry far more than we are used to giving it in formal treatises. Yet feelings are the sign of life, where emotion, intellect and the senses combine, and Birch is keen to place this at the centre of his philosophy, not least because it links us to the non-human world.

It is a long way from Charles’ self-described fundamentalist Christian youth, with its fixed doctrines and literal reading of the Bible. One can only envy the journey that led him away from those early Evangelical Union days at the University of Melbourne and took him to the University of Chicago and Columbia University in the 1940s and 1950s where he was exposed to some of the greatest thinkers of the 20th century. They included Paul Tillich and Reinhold Niebuhr, lighting the path to liberal theology, and Charles Hartshorne whose mentor was Alfred North Whitehead, providing the entrée to process thought. Many more scholars, including evolutionary biologist Theodosius Dobzhansky and HG Andrewartha in Adelaide would become mentors and friends. The young Australian responded wholeheartedly to the challenges they posed a post-war world where both religious and scientific
orthodoxies lay shattered and new paradigms were in the making. However, it would be process thought, which seeks to reconcile the diverse aspects of nature, and emphasises the developmental or becoming aspect of existence, that gave Birch the framework to reform his Christian faith into a theological and scientific synthesis. Others, such as theologian Harry Emerson Fosdick, the first minister of Riverside Church in New York, enabled Birch to think of Jesus as an affirmation of human nature, not as God: ‘The God who was in Jesus … is the same God who is in us.’

Science, philosophy and theology can sound like hard work, and articulating an integrated worldview can lack an emotional appeal in academic writing. By contrast the Bible is richly served by the ardour and exuberance of the Psalms. This is where Charles’ obvious love for poetry, especially the English Romantics, comes to the rescue. In so many of his books, his perfectly chosen poems stand as beacons, shining forth a vision that can make all the reasoned arguments seem but pale imitations. To them I return again and again, lingering over their artful encapsulation of the message of his work, like this fragment by the poet George Matheson:

I give Thee back the life I owe,
That in Thine ocean depths its flow
May richer, fuller be.

With this memoir, the future of ecology, faith and philosophy will hopefully run to richer and fuller depths, knowing where some of their seminal ideas were born and matured, and were given full expression by Australia’s unique scientist and theologian, Charles Birch.

*Rachael Kohn*
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INTRODUCTION

Build thee more stately mansions,
O my soul.

Oliver Wendell Holmes
‘The Chambered Nautilus’

This book has a twofold origin. One of my professional colleagues suggested I should write about the people who influenced me as I knew them, not how others might have known them. Other colleagues suggested I should write a non-technical account of my view of life, known as process thought, as I understand it. I have tried to put these two proposals together. Indeed, one follows from the other as the people I have known contributed to my view of life. They are evolutionary biologists, ecologists, philosophers of religion and those concerned with science and religion.

My list of mentors does not include many important people in their areas because I did not know them well, or they did not greatly influence me. My emphasis is anecdotal and includes personal aspects and philosophical convictions. The living are, with some exceptions, not included except tangentially. For example, the discussion under the late Charles Hartshorne includes other process philosophers such as the contemporary John Cobb.

I try to be objective, but without the boldness of Alfred North Whitehead when he said of evolutionary biologist Thomas Henry Huxley:
He was just under the first rank, immensely able, but not as great as [Charles] Darwin. Darwin, on the other hand, is truly great but he is the dullest great man I can think of [Price 1954 p 283].

With fear and trembling
‘Work out your salvation with fear and trembling’ said St Paul (in Philippians 2:12). But it helps to have someone hold your trembling hand from time to time. And that applies not just to the weak but also to the strong. This is what Charles Darwin said about his time in college in Cambridge and in particular about his college friend Professor John Stevens Henslow:

You have been the making of me from the first. I should never have cared much about natural history if it had not been for our friendship in Cambridge. And now much later on you have helped me make the most of the result of my voyage of discovery.

So it was with my mentors.

The answers are changing
William Sloane Coffin, when chaplain of Yale University, said that we can build a community out of seekers of truth but not out of possessors of truth. By possessors of truth he meant people who know it all and can learn from no one who has a different view of life and its meaning. It is my experience that those who have genuine convictions about the truth stay seekers all their lives. The truth may have been delivered once and for all to the saints. It is not delivered that way to us. Creeds may be good signposts. But they are bad hitching posts. They may be important starting points for an endless adventure.
A professor showed a visitor around his department. ‘And how do you examine the students?’ asked the visitor. ‘That’s easy’ said the professor. ‘We ask them the same questions each year.’ ‘But doesn’t that make it too easy for the students?’ ‘No’ said the professor. ‘We change the answers.’

The answers are changing. For one thing the more we know the more there is to be known. Knowledge and understanding are not like a field with a fence around them. They are more like the surface of a balloon that is expanding all the time, with the surface coming into contact with an ever-widening area. In that endeavour Darwin said that ‘looking back I think it was more difficult to see what the problems were than to solve them’. I think that is true of my mentors.

**Science and religion are endlessly modifiable**

Some people fear that science will eventually explain everything, that it will turn us and our knowledge into assemblages of molecules and sterile equations. After all physicists have talked about their quest for the ‘theory that explains everything’. But they don’t mean everything. They mean by everything the theory that will account for both relativity and quantum theory. That’s not everything! An explanation of everything will never happen. This is because for every question answered a dozen new ones appear. And they are usually more challenging than the prior problems. Our present knowledge is but a drop in the ocean. Biologist TH Huxley said that life is not only stranger than we imagine, it is stranger than we can imagine.

Toward the end of his life Isaac Newton could still say:
I know not what the world may think of my labours, but to myself it seems I have been but as a child playing on the seashore; now finding some pebble rather more polished, and now some shell rather more agreeably variegated than another, while the immense ocean of truth extended itself unexplored before me [Anon 1954 p 761].

Science draws its strength from its cumulative nature in an infinite quest. In that quest later results modify earlier ones.

There is every reason why religion, like science, ought to be endlessly modifiable. But this is unlikely when religion claims that its truth comes via revelation. Truth is discovered by the mind so that every affirmation on any topic is subject to a critique as in science. Their validity and value change over time as is evident in the lives of many of my mentors such as Harry Emerson Fosdick. When people ask me if my views have changed over time I reply ‘yes’ and ‘no’. Some foundational ideas stay, new ones are added, others change and yet others are cast aside. We should not throw away our tentative convictions leaving a vacuum before we have at least an inkling of what is to fill that vacuum. Otherwise the later state will be worse than the earlier.

**Making explicable the inexplicable**

There are some who draw a very narrow boundary to science, such as the proponents of so-called ‘intelligent design’. Champions of this theory imply an ‘intelligent designer’ to be the cause of the order in nature. So what science has not yet explained, they claim, must be the result of a miracle such as a miraculous creation rather than the scientific understanding of evolution for the origin and evolution of life. This theory is the fruit of minds that regard that which has not yet been explained as inexplicable. In this view
science has limited relevance. But the history of science is the history of that which was inexplicable becoming in time explicable. The order of nature or so-called design of nature was inexplicable in the 18th century. The dilemma was supposedly resolved by appealing to the supernatural and invoking a designer of nature, namely the deistic God. In the 19th century Darwin gave us a naturalistic explanation of creation in his theory of the origin of species. It involved three concepts: struggle for existence, variation and natural selection. They have been extensively investigated and, over time, developed in a way Darwin could hardly have foretold. No scientist could subscribe without qualification to Galileo’s or Newton’s beliefs or to his own beliefs of 10 years ago. But this is not a sign of defeat. Whitehead (1933b p 231) says that in the evolution of knowledge a contradiction can mark the first step in progress and this is one reason for tolerance of a variety of opinions. He reminds us that the duty of toleration is summed up in the biblical words ‘Let both grow together until the harvest’ (Matthew 13:30). Oliver Cromwell’s cry echoes down the ages ‘My brethren, by the bowels of Christ I beseech you, bethink you that you may be mistaken.’

Religion, said Whitehead, has to face change in the same way science does. ‘Its principles may be eternal, but the expression of those principles requires continual development’ (Whitehead 1933b p 234).

Whitehead said we may never fully understand but we can increase our penetration. After a lengthy discussion in committee on a difficult subject the first general secretary of the World Council of Churches remarked to a friend of mine that he was still confused but at a higher level! The role of reasoning in religion and science is to lead to understanding, not to proof. Our first understanding
may well be in terms of a simple model. This was true of my own understanding of religion (as I describe). In my scientific field of population biology one approach is in terms of fairly simple mathematical models. This is valid so far as it goes, but it needs to be confronted with the complexity of nature which the field naturalist knows. In many cases nature is not simple at all.

While pursuing science as far as it goes it does not follow that science is the only source of knowledge. Science does not exhaust the content of things. It is not the only activity of the human spirit.

Knowledge shrinks as wisdom grows

In science and religion our first understanding is necessarily overtly simple. But we should not stay there if we are to have a mature understanding. We come to mistrust our simple understanding. Many, for example fundamentalists, stop there. ‘Seek simplicity’ said Whitehead ‘and mistrust it.’ The point is that mistrust can lead to a richer and more mature understanding that we were unable to appreciate in our earlier simple understanding. We convert the demise of one level of understanding into the birth of a successor. People worry about the impossibility of keeping pace with the huge increase in knowledge. But therein lies a fallacy. Knowledge shrinks as wisdom grows. This is because details are swallowed up in principles. The function of education is to shed details in favour of principles. In the process we may change our interpretation of what we are doing, though most scientists avoid this sort of philosophical analysis. By the sixth edition of The Origin of Species in 1876 Charles Darwin had convinced himself that he had been a good Baconian scientist, that is to say he thought he was immersing himself in a plethora of facts in nature that eventually spelled out a story. But his correspondence and autobiography tell a different
story. He declared, for example, that he could not resist forming a hypothesis on every subject. He went into the jungle not with an empty head but with ideas hoping to find data to convince him one way or the other. Thought precedes imagination. Darwin had the germ of the idea of natural selection well before he had read Thomas Malthus, whose ideas on population were so influential in the formulation of Darwin’s ideas on natural selection.

**To fill up or draw out?**

A university president once stated that his university was a reservoir of learning. Everybody brought some knowledge to it but no one took any away! The supply of knowledge is not like a service station from which one gets measured quantities of gas; it isn’t about filling up. The root meaning of education is about drawing out. One of the most wonderful conversations between a teacher and a student is that between Plato and a slave named Meno in Plato’s dialogue of that name. Plato doesn’t tell him anything. He asks questions and draws the slave out. The slave finds the answers himself prompted by Plato. It is called non-directive counselling. Jesus did the same with the Samaritan woman by the well. He drew her out by asking questions about the well of water that could spring up forever in her life and so transform her. Education is like that. We ask questions about ourselves usually as a result of a challenge. Reinhold Niebuhr recognised two crises in knowledge which children face. One is when they find out that their parents are not as powerful as they thought. The second is when they find that their parents are not as good as they thought.
My purpose
I have published a number of books on different aspects of my worldview, which is known as process thought (see Birch in references), and which I explain later. None of these books covers the whole in synoptic form. The last two chapters in this book are not so much an account of what process thought is, but an account of what it means to me. Some things others may consider significant I have left out because they have not been important to me.

I am a biologist and so my scientific examples are mostly from biology, particularly evolutionary biology. Since the Renaissance two revolutions in biology have marked the birth of modern mechanistic biology. The first revolution came from René Descartes (*bête machine*) and William Harvey (the circulation of the blood). The second was Darwinism. Although *The Origin of Species* appeared in 1859 it was not until the 1940s that Darwinism really established itself in most branches of biology. These two revolutions are reflected in the thought of those who have influenced me. The organic philosophy of process thought was epitomised by AN Whitehead. It is a non-mechanistic, yet a fully scientific, understanding of nature.

Dogmatic fallacy
Profound as his views are Whitehead never regarded them as final statements or dogmas. ‘There are no full truths’ he said, ‘all truths are half truths.’ Furthermore Whitehead (1929 p xiv) reflected ‘how shallow, puny, and imperfect are efforts to sound the depths in the nature of things. In philosophical discussion, the merest hint of dogmatic certainty as to the finality of statement is an exhibition of folly.’ The dogmatic fallacy is ‘the belief that the principles of its [the dogma’s] working hypotheses are clear,
obvious and irreformable’ (Whitehead 1933a p 223). Dogmas may appear clear because they are simplistic, they may appear obvious because they exclude ramifications, and irreformable because they are regarded as unchanging truth.

The philosopher of science Charles Sanders Peirce said that the conclusions of science make no pretence to being more than probable. Degrees of certainty exist even there. In any particular case it may be difficult to put a figure on it. But at least we can recognise that 100 per cent certainty on complex issues is unlikely.

We make generalisations from experience. They are what Whitehead called ‘adventures of ideas’. For some of us they have become the most exciting adventure of our lives. It is to boldly frame a system of ideas in terms of which every element of our experience can be interpreted. Every in this sentence covers the five senses of ‘sensationalism’ and non-sense experiences such as subjective valuation. That is the challenge. Degrees of uncertainty imply taking risks. Whitehead is aware of the risk in venturing into uncharted waters. It leads him to say ‘It is the business of the future to be dangerous’ (Whitehead 1933b p 259). It is better to take risks and fail than to take no risks at all.

Fallacy of misplaced concreteness
The mechanistic theory of nature has reigned supreme since the 17th century. It is the model of nature as machinery. It was the orthodox creed of physics until the rise of quantum theory and is still the orthodox creed of biology. It has been highly successful in investigating those aspects of nature which are like machines, the heart as a pump and aspects of the brain like a computer. But it has been less successful as a guide to subjective aspects of nature such as feelings. To say that the heart or the atom is like machinery is a
valid statement, but to say that they are machines is to commit what Whitehead (1933a p 64) called the fallacy of misplaced concreteness. It is to mistake the abstract for the concrete. Mechanism is an abstraction from nature. It is not concrete nature. Much of what I have to say of my view of life is a critique of materialism and a promotion of an organic view of nature. It is an attempt to give an appropriate place to subjective feelings. Cobb (1989 p 41) points out that avoiding misplaced concreteness is not easy. We cannot think without abstractions. To abstract literally means ‘to draw away from’. We can draw away from concrete experience in different directions, but perhaps we shall never succeed completely.

**Objectivity and subjectivity**

When I look at a European forest in Spring I experience the colour green. In the Autumn I experience it as mostly the colour brown. These are two different experiences. In analysing these experiences the scientist gives us objective information. He might tell us that the experience of colour is associated with a particular area of the brain, that greenness is associated with electrical impulses in certain nerve cells in this area and that brownness is associated with electrical impulses in other cells. These are the biological correlates of the experience of colour. But there is also the subjective aspect of experience which is the feeling we ourselves have. There is a gap between the experience we have and what science has to tell us about it. Once you have the objective facts about an experience there are a lot of subjective facts left over such as my desires and my pains. The proposition here is that conscious experience is not simply reducible to what science as we know it has to tell us. Process thought is an attempt to bring the two together (as I hope to demonstrate).
‘Nothing but’ philosophies

We live at a time of ‘nothing but’ philosophies. Each of us is nothing but a pack of nerve cells, says the neurophysiologist. The human mind is nothing but a computer programme, says the exponent of artificial intelligence. We are nothing but lumbering robots whose genes create us body and soul, says the sociobiologist. My response to all these statements is: none of the above. I recall a Viennese joke about two neighbours. One of them contended that the other’s cat had stolen and eaten two kilos of butter. There was a bitter argument and finally they agreed to seek the advice of a rabbi. They went to the rabbi and the owner of the cat said ‘It cannot be my cat, it does not eat butter.’ The other insisted the cat did it. ‘Bring me the cat’ said the rabbi. They brought the cat to him and the rabbi said ‘Bring me the scales.’ They brought the scales and the rabbi asked, ‘How many kilos of butter?’ ‘Two kilos’ said the complaining neighbour. Believe it or not the weight of the cat was exactly two kilos. So the rabbi said, ‘Now I have the butter, but where is the cat?’ We may well ask the ‘nothing but’ philosophers: ‘But where is the human?’ Whitehead finds something missing in Darwinism when he says ‘Darwin and Huxley had grasped the principle of evolution but it never occurred to them to ask how evolution of materials could result in a man like, let us say, Newton’ (Price 1954 p 283). Where in Darwinism is the human? Where is Newton? These are central questions for process thought which I discuss in some detail later.

It is obvious that my list of persons who influenced me reflects the meaning of life I have come to understand. I present my case with reference to the nature of contrary points of view without analysing these in detail. I have about 20 persons in my list of those I knew well and my account of them comes first. It
is not primarily an account of their work but their thoughts and personality. My project grew from that beginning. I ask: ‘What do all these influences add up to in my own thinking and ideas?’ My answer is in Chapters 5 and 6.

On being interesting even if not true
Of my mentors it could be said that what they said and wrote was interesting. I doubt that I would have been drawn to them but for this. JBS Haldane urged his colleagues to produce something that was ‘interesting, even if not true’. Whitehead (1929 p 259) in a similar vein said ‘In the real world it is more important that a proposition be interesting than that it be true. The importance of truth is that it adds to interest.’ He was not saying truth was unimportant. He was saying that the important thing was to be interesting and that would lead to truth.

I am compelled to add that what I have written are my convictions and in particular my understanding of process thought. It may be that some of my propositions are contradictory. Others may be judged as superficial, for I may say in one sentence what the expert puts in 20! My brevity may lead to greater clarity. At least that is my hope. In biology laboratory rats are trained to make their way through a maze to find their reward of food. I find myself in a maze in which some of the alleys are blind. But not all.

O world invisible, we view thee,
O world intangible, we touch thee,
O world unknowable, we know thee,
Inapprehensible, we clutch thee!

[Francis Thompson, ‘The Kingdom of God’]
Evolutionary biologists filled the missing links in Charles Darwin’s theory of the mechanism of evolution. They are, for the most part, geneticists who had to do with the origin and inheritance of genetic variation. This was the major missing element in Darwin’s theory. The reason is simple. When Darwin wrote *The Origin of Species* there was no substantial understanding of genetics. The combination of Darwinism and genetics became known as the evolutionary synthesis or neo-Darwinism. It was established in the first half of the 20th century. Its founders were Ronald Fisher and JBS Haldane in England, Sewall Wright and Theodosius Dobzhansky in the USA and SS Chetverikov in Russia. Five books published between 1937 and 1950 established evolutionary synthesis as the new foundation of evolutionary biology. In chronological order these books were: *Genetics and the Origin of Species*, by Theodosius Dobzhansky (1937); *Evolution: The modern synthesis*, by Julian Huxley (1942); *Systematics and the Origin of Species*, by Ernst Mayr (1942); *Tempo and Mode in Evolution*, by George Gaylord Simpson (1944) and *Variation and Evolution in Plants*, by Ledyard Stebbins (1950).

The genetic theory of Darwinian evolution heralded a revolution in biology that has continued to this day. It is comparable to the later one in molecular biology, when James Watson and Francis Crick in 1953 discovered the molecular structure of DNA.
I am not primarily a geneticist, so what had I to do with evolutionary biologists? The answer is that evolutionary biology has another side to it besides genetics, and that is ecology. If you read Chapter 3 of Darwin’s *The Origin of Species* entitled ‘Struggle for Existence’ you will be reading a great work in ecology. I am an ecologist and that explains my involvement in evolution. Here is just one example. An insect called the Queensland fruit fly is native to Queensland. It lays its eggs into ripe fruit that is eaten by the larvae that hatch from the eggs. In the Australian tropics wild fruits grow in abundance, a veritable feast for the fruit fly. But south of the tropics few native soft fruits existed until humans planted fruit trees. The fruit fly spread thousands of kilometres to the southern states following the planting of fruit trees. It came to thrive in non-tropical climates. My colleagues and I were able to show that the fruit fly was able to spread because its genetic constitution changed to enable it to live beyond the tropics. This is an evolutionary change sometimes referred to as micro-evolution. The point is that the distribution and abundance of the Queensland fruit fly, its ecology, could be understood by studying not only its ecology but its evolutionary genetics also. So an ecologist needs to know something about evolutionary biology. That is how I became involved with the evolutionary biologists discussed in this section. My closest association was with the geneticists Theodosius Dobzhansky and Sewall Wright in the USA. I went to Columbia University in New York for a year and to Brazil for a year to work with Dobzhansky and he came to work with me in the University of Sydney for the best part of a year. I learned about genetics. He learned about ecology.

There are many distinguished evolutionary biologists, such as Ernst Mayr (ornithologist) and George Gaylord Simpson (palaeontologist), whose work is not discussed in this chapter. I
knew them when both were at Columbia University but with a lesser involvement than I had with those discussed in this chapter. The purpose of this chapter is not to discuss evolutionary biology in detail, but some of the people behind it, their particular human characteristics and their philosophy of life, as I understood it. I was particularly interested as to whether they were materialists or not and how they reacted to my philosophy of life, which is non-materialistic.

Theodosius Dobzhansky

Theodosius Dobzhansky (known to his colleagues as Doby or Dodick) was one of the founders of the evolutionary synthesis of Darwinism and genetics, sometimes known as neo-Darwinism, in the first half of the 20th century. Dobzhansky demonstrated the importance of genetic variation between individuals at the level of the gene and the chromosome. This has been the cumulative work of 50 years. ‘What is remarkable about the development of this work’ says Richard Lewontin ‘is that a single central figure,
Theodosius Dobzhansky, planned and carried out the largest part of the experiments, and much of what has been done by others has been inspired by his work and ideas’ (Lewontin 1981 p 94).

I first met Dobzhansky when I was on my way through New York to spend a year in the University of Chicago in 1946. I called upon him at Columbia University in New York where he was a professor of genetics. He pulled out from a drawer a recent paper by himself and Sewall Wright (of the University of Chicago) which clearly demonstrated Darwinian natural selection in nature. He had good evidence that the genetic constitution of populations of the fruit fly *Drosophila pseudoobscura* changed adaptively with the seasons and from place to place. It fitted well with the mathematical model of Sewall Wright. Pointing to the mathematics in the paper Dobzhansky said to me: ‘that’s Sewall Wright, the data from the field and from the lab is mine’.

So began a friendship with Dobzhansky which continued until his death in 1975. He was the age of the century. I still have the telegram telling me of his death (from leukaemia) from professor Ledyard Stebbins at the University of California in Davis ‘Dobzhansky died suddenly 10.30 am December 18’. The *New York Times* ran a long obituary the next day. It commented on his book *Genetics and the Origin of Species* (1937) as ‘one of the most important books of its kind since Charles Darwin’s classic volume’. It has been described as a landmark work indicating a new stage in the problems of evolution in terms of modern cytogenetics. In his book Dobzhansky stated his profound belief that ‘Nothing in biology makes sense except in the light of evolution.’

I worked with Dobzhansky at Columbia University in 1953 and in Brazil in 1955. Dobzhansky spent most of 1960 at the School of Biological Sciences, University of Sydney in joint projects. At the
University of Sao Paulo four of us, Dobzhansky, Bruno Battaglia of Padua, Ove Friedenberg of Copenhagen and myself were financed by an organisation called ‘Organisation for the promotion of superior people in Brazil’! The superior people were not us but students. This project was also financed by the Rockefeller Foundation in New York. Besides our teaching, we had research projects, the main one being on tropical islands south of Rio at Angra dos Reis (Haven of Kings). The project was to use some of the islands as giant ‘cages’ for experiments on natural selection in fruit flies. It involved many enjoyable visits to this tropical haven. In the end it seemed that our islands were not as isolated as they needed to be for the purposes of our experiments, and the projects had to be abandoned. However, we did research on other topics that added to our knowledge of natural selection in nature.

In Sao Paulo I shared with Dobzhansky a room in a pension in Avenida Sao Paulo within walking distance of the laboratory. We had a strict routine each day. It included a brief siesta after a heavy mid-day meal. On the first Wednesday Dobzhansky disappeared for a while, returning in the late afternoon with a dozen cream cakes which he purchased downtown. I found some difficulty in consuming my half. When the next Wednesday came he said to me, now it is your turn to get the dozen cream cakes. What you ask for is ‘un doze doces’. I duly found the cake shop but had difficulty with my Portuguese and eventually had to point to what I wanted. When I got back with my purchase Dobzhansky told me that I had said to the girl behind the counter: ‘You sweet of sweets!’ Well I wonder. For some weeks I kept up with this routine until six cream cakes became too much for me. I announced that I couldn’t cope any more. ‘You must be sick,’ he said. But I stuck to my guns about the cakes.
Every Sunday night we would walk towards the city down Avenida Sao Paulo to a rather uninviting white-tiled restaurant where we always ordered Soupa de Palmeto; soup made from the heart of palms. These were happy interludes in between serious work and also what Dobzhansky found exasperating periods of Brazilian casualness. On one occasion all was teed up for going to Angra dos Reis when the Brazilian professor, Crodowaldo Pavan, decided to attend a wedding instead. Then there were political disruptions called sieges when banks, post offices and all government offices came to a standstill. Our lab happened to be a stone’s throw from the palace of the governor of the state of Sao Paulo, Janio Quadros. He was at loggerheads with the mayor of the city and had issued instructions that all repairs of the city’s buses cease. On this day we heard a commotion and there was the governor chasing the mayor out of the palace gates. So were political battles dealt with. Janio Quadros later became president of Brazil.

Cuiabá is the capital of the state of Mato Grosso. A stone column standing in the middle of the town claims it to be the geographic centre of South America. On our visit it was a sleepy town of 3000 inhabitants and also a refuge for escaped Nazis. When we asked a citizen leaning against a lamp post what he did he said ‘I live here’, which was an unexpected but good reply. Our objective was to collect fruit flies at the southern edge of the Amazon rainforest. To get there we needed the services of the secretary of a rubber collecting company that tapped native rubber trees in the region. His name was Prince Eugene Wittelsbach of the royal house of Bavaria and said to be an ex-professor of philosophy in Germany. In the process of trying to find the prince we sought the mayor, by knocking on many doors. Along the way we met a lad whose name was Hitler but since h’s are silent in Portuguese he
went under the name Itle. At the airport we were accosted by an American missionary who wanted to know if Dobzhansky was saved. Dobzhansky found this very embarrassing so I replied on his behalf. I remembered later that an appropriate reply would have been: ‘I’m damned if I’m not.’

From the Cuiabá airstrip the prince flew us in a small aircraft for two hours north to the field headquarters of his rubber company on the southern edge of the Amazonian rainforest. Here was a small wooden shack which was a dormitory for the rubber workers. We had it to ourselves. Despite the heat the wooden shutters were locked at night and under each pillow was a pistol. Back in Cuiabá we had hammocks for the night. Dobzhansky identified on my hammock a Reduviidae bug responsible for the transmission of Chagas disease otherwise known as *Brazilian trypanosomiasis*. Charles Darwin had symptoms which some interpreted as Chagas disease acquired in South America. On 26 March 1835, when spending a night in a village in the Argentine province of Mendoza, Darwin was bitten by the blood-sucking bug that is vector of the micro-organism *Trypanosome cruzi*. He may have contracted the disease. He was sick for the last 40 years of his life. I don’t think I was bitten by the offending bug.

Despite the rigours of fruit fly-hunting Dobzhansky showed incredible excitement and enthusiasm to be anywhere near a tropical rainforest that would have its special fruit flies waiting for him.

One of Dobzhansky’s great enthusiasms was horse riding. An opportunity came high up in the Andes where Chile meets Argentina. He thought this was my chance too and pressed a horse upon me, even though I had never been riding before. So we set out to get a good view of Aconcagua, the highest mountain in the western world. My horse had its own ideas; one being to get as close as it
could to the edge of a huge canyon. At intervals crosses indicated that someone had lost their life. My horse galloped on regardless of my attempts to control it. Dobzhansky rode stately ahead, greatly amused at my incompetence which he thought was unfitting for an Australian. I spent the next day in bed and never rode again.

After adventuring in the Andes Dobzhansky had to return to his missionary quest. He travelled to Punta Arenas (which claims to be the southernmost city in the world at 53 degrees south) where he gave lectures on genetics and thus ‘preach[ed] the gospel of genetics to the uttermost ends of the Earth’.

Early on in my year at Columbia University Dick Lewontin (now a professor at Harvard University) ‘the smartest man I have ever met’ (wrote Stephen Jay Gould), was then a graduate student of Dobzhansky. He and I were having a lively conversation in my lab. Dobzhansky knocked on the door, entered and asked what we were discussing. Lewontin replied to his supervisor that he wouldn’t understand for we were discussing philosophy! Dobzhansky didn’t take kindly to this remark from a graduate student but came to me later to say he was interested and invited me to his home for a discussion. He was deeply spiritually attached to his native Russia, had strong bonds with the Russian Orthodox Church, though he was not a regular worshiper. He had imbibed much from Fyodor Dostoevsky, Nicholas Bergaev and Leo Tolstoy and more recently from Pierre Teilhard de Chardin. And so that evening began a discussion between us on philosophy and religion that lasted through the decades ahead.

I was at that time attending a course on Protestantism and Culture at Columbia University given by the eminent theologian Paul Tillich. I invited Dobzhansky to join me, which he did. He was very taken by the famous Tillich phrase ‘ultimate concern’ (see
Chapter 3). We have many concerns that are secondary. But some are ultimate in the sense of fulfilling life. This too is Tillich’s meaning of God in human life. Instead of using the name ‘God’ he replaces it with the two words: ‘ultimate concern’. The immediate issue for Dobzhansky was a biological one. Why should we have evolved such concern? He gave his answer in a book with the unusual title *The Biology of Ultimate Concern* (1967). There is not much Tillich in this book but it did give, for the first time, Dobzhansky’s philosophy of religion. The final chapter ‘The Teilhardian Synthesis’ came as a shock to his colleagues, particularly to Professor Ernst Mayr and Professor GG Simpson, both stalwarts of a strictly mechanistic view of evolution. Teilhard was a Jesuit and palaeontologist and had a strong mystical component in his synthesis, which had become widely known through his book *The Phenomenon of Man* (1955). Geneticists blamed me for having led Dobzhansky astray. But that was not the case. Dobzhansky was taken by Teilhard’s concept of evolution having an ultimate goal: the Omega point. On the other hand Dobzhansky rejected a central Teilhardian concept ‘the inner aspect’ of all entities. This concept is akin to a view known variously as panpsychism, process thought, panexperientialism and pansubjectivism (see Chapters 5 and 6). It has been advanced by eminent philosophers such as AN Whitehead and Charles Hartshorne as well as by distinguished biologists such as Sewall Wright, Bernhard Rensch, Alister Hardy and Conrad H Waddington. Being a supporter of this concept myself I have had many discussions with Dobzhansky on it. The critical issue is: ‘Can mind evolve from no mind?’ We come to that question again when we discuss Sewall Wright whose answer was ‘no’ while Dobzhansky’s answer was ‘yes’. The question reveals a philosophical divide between biologists and is pursued in later chapters.
Colleagues have asked me if Dobzhansky had traditional religious views. I know he sporadically attended a Russian Orthodox liturgy at the church of Saint Seraphin in New York. And he had an honorary doctorate in theology from the Russian Orthodox Seminary in New York. Unknown to most of his colleagues he spent at least a week at the monastery on Mount Athos in Greece in his latter years. He had a fairly orthodox view of the resurrection and other doctrines. The liturgy seemed to fill a lot of spaces. The one occasion of the liturgy which I experienced in Tambov in central Russia filled me with awe as I witnessed the eager response of peasants. It filled something missing in their lives, which Tolstoy wished he had too. I think it did that also for Dobzhansky, even though he only attended the liturgy rarely. He was extremely emotional about situations such as experiencing a rainforest in the tropics or being in a place for the last time. When we came upon the Christ of the Andes high in the mountains facing the Pacific Ocean I took a photo of Dobzhansky that could be called ‘Dobzhansky of the Andes’. This was a spiritual moment. Religion for him was emotional rather than cognitive. Memory too could be a highly emotive experience. When I visited him three months before his death he envied me the years that were between us and which were gone for him. He desperately wanted not to die. Following publication of *The Biology of Ultimate Concern* he sent me copies of correspondence between himself and Ernest Nagel who was at that time professor of philosophy at the Rockefeller University in New York. After reading this book Nagel wrote to Dobzhansky:

> My main difficulty is with the supposition that life in general, as distinct from individual living creatures who are capable of deliberation and choice, might have a ‘meaning’ – especially
since I believe with you that no ‘aim’ or ‘purpose’ directs the course of either cosmic or biological evolution … I fail to grasp why a man’s life can be genuinely meaningful only if his efforts are believed to contribute to the realization of some inclusive global goal, or only if he is committed to the view that cosmic changes are in some sense ‘progressive’ … human lives can be meaningful even though the lot of man is eventual oblivion.

Dobzhansky replied in no uncertain terms:

I must disagree with you if by ‘human lives can be meaningful, even though the lot of man is eventual oblivion’ you mean the lot of mankind rather than as a person. No, if mankind ends in oblivion, life becomes extinct, and the universe lifeless and ‘spiritless’, then I want no part in this ‘devil’s vaudeville’. This, of course, is the old Dostoevskian problem, and this is the heart of my ‘religion’, as it was the heart of Teilhard’s religion … This does not mean that there exists an ‘aim’ or ‘purpose’ directing evolution by sticking its little finger into the machinery at critical moments to make it work according to the ‘aim’. I have tried to make clear the absence of ‘God of the gaps’. Should we accordingly abandon the hope that the universe is some sort of an undertaking? The wish surely may be the father of hope. But this wish is the true Dostoevskian style (after all I am his remote relative), too strong in me to resist.

Dobzhansky accepted the probability that life would become extinct on Earth. He could not accept that this would be the end of all that might have been achieved in cosmic, biological and cultural evolution. He could not face life with the view that man gives himself meaning in a universe itself devoid of meaning and value. He was convinced that if we have no value for the cosmos, we have no value period. We return to this issue in Chapters 5 and 6.
Two things deeply influenced Dobzhansky’s understanding of life. One was the war years of his youth in Russia. The other was his adventurous life as a naturalist beginning in the Caucasus and eventually extending from Alaska to Tierra del Fuego. He was born in the small city of Nemirov in the Ukraine in 1900. Great social and political unrest stirred Kiev during the last years of World War I and the beginning of the Bolshevik era. Fifteen changes of government rocked Kiev from 1917 to 1920. In May 1920 Dobzhansky and his mother were literally starving. Dobzhansky went in search of food and came home with a piece of stale bread. His mother choked on the morsel and died within minutes. Life was precarious for Dobzhansky until 1927 when Dobzhansky and his wife Natasha went to Columbia University in New York, with the help of the Rockefeller Foundation, to work with the famous geneticist TH Morgan. He never returned to Russia.

I remember Dobzhansky as the most electrically energetic scientist I have ever known. He was enthusiastic for science in season and out of season. That is revealed in the many students who wanted to study under him and who became infected with his enthusiasm. His greatest student was Richard Lewontin now professor at Harvard University.

In some places the image of the scientist as a cold and passionless person is still propagated. Dobzhansky incarnated the opposite: a person of flesh and blood, of passion and drive, of daring and courage. He argued with great vigour. The decibels would rise to a great crescendo. I recall Dick Lewontin saying that when he eventually conceded that you may have one chance in a thousand of being right then you had won the argument. I never won the argument with him about the basic nature of the world whether it consists of bits of mere matter or whether its ultimate entities have
a subjective or mental aspect to them. The latter is what I argue for. Teilhard de Chardin, whom Dobzhansky admired, spoke of ‘the inner aspects of things’, by which he referred to the subjective nature of entities such as electrons and molecules as well as human beings and other living creatures. Dobzhansky simply ignored this part of Teilhard’s thesis. He seemed not to like entertaining this concept in his mind and would dismiss the subject in caricature. This puzzled me as I regard the issue of great importance in my philosophy of life as I try to show later. Perhaps it has taught me that great minds such as Dobzhansky and the evolutionary biologist Sewall Wright (see later) can look at the same world and reach quite different conclusions. But, of course, it is not the same world they look at. The emperor has no clothes.

Dobzhansky was no narrow specialist, but lectured and wrote very successfully for a wider public on social and ethical issues. His mind was razor sharp getting to the point while we lesser mortals were still struggling. We also remember him as a deeply affectionate friend.

It was partly Dobzhansky’s friendship with Professor Michael Lerner of the department of genetics at the University of California, Berkeley, that I was invited to teach for a semester in Lerner’s department in 1960. There was a second reason and that was Lerner’s interest in ethical issues in genetics. Yet a third and probably the most important reason for the invitation at that time was that it was the height of student protest against the Vietnam War and was also the height of the hippie movement amongst students. Lerner was interested in all these issues and knew I would be also. My official responsibilities were to give an undergraduate course in evolution and a graduate seminar in population biology (evolution and ecology). My introduction to
students was in a bookshop in Telegraph Avenue. I was looking at a book on the shelf and a student nearby turned to me with an open book and said: ‘Look at this, it will blow your mind!’ I just couldn’t imagine that happening in Sydney. My undergraduate class turned up with balloons and flowers and their dogs. I was given an apple for the teacher. What impressed me most were the weekly protest meetings outside the main administration building. Those against the Vietnam War had formed a Committee on Conscience to support students who refused to be called up for war service. The committee consisted of students and staff. On my return to Sydney I immediately formed a Committee on Conscience there. It became known to students through mass lunch-hour meetings on the front lawn of the University of Sydney. We offered free legal advice and friendly help as well as visits to prison (in some cases). I remember giving Dietrich Bonhoeffer’s *Letters and Papers from Prison* to one such inmate. Newspaper headlines said that we were committing an offence against the *Crimes Act* because of our encouragement of opposition to conscription. I received dozens of telegrams from trade union leaders around Australia supporting our activities. I felt very secure. But more important was what was happening to those students involved in the Committee on Conscience. One of them said to me: ‘This has been a cathartic experience.’ Involved together with staff they, for the first time, shared experiences that could be life-shattering. In many ways it was the most memorable encounter I had ever had with students. I recall it vividly to this day.

Perhaps equal to this experience was another relating to refugee students after World War II. An organisation called World Student Relief (WSR) had been created in Europe to help university students who had become refugees. Many of them were bound for Australia. I first met some of them in Grindelwald in Switzerland in 1947.
Here some were gathered by WSR as a sort of rehabilitation in this beautiful alpine setting. I shared a room with a German student who had been captured by Australian troops in North Africa and sent to Canada as a prisoner of war. So at an earlier time in his life I would have been his enemy! That realisation left an indelible mark on my mind. When I returned to Australia WSR sent to me the names of students on each refugee boat arriving in Australia. Each one of them had a free passage, but was committed to work for the government for three years on assigned projects such as in a cement factory or similar manual work. Life was tough for them. A member of the staff of the Student Christian Movement, the saintly Rosalie McCutcheon, and I would meet these boats and make contact with the refugees and introduce them to fellow students in Australia as their first Australian contacts. They were helped eventually to continue university studies. Some did brilliantly. For others life problems were overwhelming and some committed suicide or ended up in mental hospitals. I have many stories. Here is just one. My secretary told me that a young man had turned up in a Cadillac and asked to see me. He said that many years before as a refugee student he had sought my advice. How could he become a student right away? My advice had been to learn English and earn some money first. He took my advice. He was now very wealthy, having spent these years, night and day, as the first manufacturer of nylon thread in Australia from its basic ingredients. He was now on his way to Pakistan to set up a plant there. He then told me he wanted to help a needy student whom I might know, in a sense pass on the favour. So I gave him a list!

Another outcome of my time at the University of California at Berkeley was one student who became interested in the philosophy of biology and bioethics. I discussed these issues in my course on
evolution. Most were not interested but Charles Taylor was. He even came to Sydney for several months to learn more about Whitehead. His interest led him to become a leading researcher in artificial intelligence and artificial life at the University of California (Los Angeles) where he is a professor deeply concerned with the ethical issues these subjects raise. In the meantime he was a PhD student of Dobzhansky who also confronted him with questions in the philosophy of biology. We remain friends in contact to this day, though our emphases are different.

Going back to Berkeley, I had long discussions with Michael Lerner about ethical issues raised by modern genetics. He was convinced that these were critical issues of immediate concern. It was partly his concern that led me to meet Carl von Weizsäcker in Hamburg for advice, since Weizsäcker had been involved in the ethical issues raised by atomic energy. Under the auspices of the World Council of Churches we had a consultation in Zurich that included Michael Lerner and resulted in the book *Genetics and the Quality of Life* by Charles Birch and Paul Abrecht.
It is well to remember that in the 1920s biologists were divided into two camps. There were Darwinians and there were Mendelians. And they were at loggerheads. It took the work of three brilliant biologists, JBS Haldane and RA Fisher in the UK and Sewall Wright in the US, independently to show that a proper theory of evolution did not have to choose between Charles Darwin and Gregor Mendel, but could combine the two in a genetic theory of natural selection. Genetics provided both the maintenance of variability and the source of variability on which natural selection acted. It was one of the great discoveries of the century which led to the elaboration of the modern theory of evolution. All three discoverers provided convincing evidence by means of theoretical models. I discuss Sewall Wright later in this book. I only knew Fisher as the provider of statistical methods that ecologists and evolutionists find essential in their work. Sir Peter Medawar described Haldane as the cleverest man he ever knew. And Richard Lewontin said
he had the most incisive and wide-ranging intellect he had ever known. I had a couple of interesting encounters with Haldane. The first time I visited him at University College in London in 1947 where he was professor of genetics. I was interested in the work he was doing on the fruit fly *Drosophila*. But I also wanted to tell him that his book *Possible Worlds* was very largely influential in my becoming a biologist. I had read it as a schoolboy and was intrigued by Haldane’s ability to write so clearly and interestingly on so many areas in biology. Typical of these essays is one entitled ‘Darwinism today’ which begins with the quotation from Hilaire Belloc ‘Darwinism is dead’ only to show that Darwinism is very much alive. I had an hour or so with Haldane who then took me to a lower floor to meet his second wife Helen Spurway, a biologist in her own right. My second connection with Haldane was when he had moved to a statistical institute in India. I sought his advice on how to measure degrees of significance in a particular demographic index. His reply was helpful and his letter ended by suggesting to me that I would be better off in India because my Whiteheadian views were, he thought, akin to those of Hinduism. He himself then wore Indian dress and had ceased to eat meat. He called himself a Hindu atheist. Yet he was not a thorough going materialist whilst most of his biological colleagues were materialists. He said on one occasion that although we do not find obvious evidence of life or mind in so-called inert matter we can study them most easily when they are most completely manifested in human beings. We shall ultimately find them, he believed, at least in rudimentary form, all through the universe (see Waddington 1963 p 118). This is a Whiteheadian or pansubjective position rather rare amongst biologists. However, this was also true of evolutionary biologist CH Waddington (see pp. 32–33).
There are countless stories about Haldane many of which I have heard from two of his former students who worked in Australia; Jim Rendel one-time chief of the CSIRO Division of Animal Genetics and Michael White one-time professor of zoology in the University of Melbourne. Rendel I knew well as we were located in the same building in the University of Sydney for several years. I was delighted to discover that he was convinced of pansubjectivism. He owed his insight to no one but himself, at least so he said. Michael White was a strict mechanist so far as I could judge. Haldane was a friend of Aldous Huxley and is the biologist Shearwater in Huxley’s novel *Antic Hay*. When asked ‘Would you lay down you life to save your brother?’ Haldane replied ‘No. But I would to save two brothers or eight cousins.’ The point being that you share 50 per cent of your genes with a brother and 12.5 per cent with a cousin.

Haldane wrote and recorded his own TV obituary, part of which was broadcast by the BBC. He died of cancer and wrote a poem soon after he was diagnosed. It was called ‘Cancer is a funny thing.’ In his self-obituary he concluded that what matters is not what people will think of him but what he’s done, good or evil. He did much good. One common theme of this group of biologists was their interest in the philosophy of biology and particularly in the question: ‘What is the origin and evolution of mentality?’ And there are others who contribute to this question. So to it we shall return.
I had many discussions with Waddington (known to his colleagues as Wad) when he was director of the Institute of Genetics in the University of Edinburgh and we were both members of the executive committee of the International Institute of Biological Sciences. Waddington was its very energetic chairman. While together in a bookshop in Rome, when he was looking for a book on how to prune olive trees on his property on the Adriatic coast, he told me that as an undergraduate in Cambridge he had read all of Whitehead’s works which are, for the most part, difficult to read. He pursued the same question as Haldane that if mind exists in the higher animals at what point in evolution did it originate? His conclusion was that it is inconceivable that it did not originate from anything that did not share something in common with it, but possessed only those qualities which can be objectively observed from outside. So we are forced to conclude, he says, that even in the simplest inanimate entities (eg, atoms) there is something akin to mentality. No system of electric currents, however complex,
running through a complicated group of cells such as the brain can produce consciousness unless we allow that it is present at least as a potentiality in the elementary units of which the system is made (such as atoms and their components). Waddington did not get this insight from Haldane but from Whitehead. Waddington tells us that his philosophical views greatly influenced his research especially the subjects he chose to work on. When I discovered these were his views I was delighted to add him to my short list of biologists who had themselves found Whitehead’s philosophy so illuminating.

While Waddington was an elder statesman of biology he was a great exponent of the new biology. In the 1960s we realised that zoology, botany, entomology and other disciplines centred on such groups of organisms that no longer reflected the reality of modern biology. Biology was now being sliced crosswise according to levels of biological organisation oriented to the molecule, cell, whole organism and the population. So appropriate subdivisions of biology would be cellular (including molecular) biology, organismic biology and population biology. When I came to press the case with the vice chancellor for a reorganisation of biology in the University of Sydney as a school of biological sciences I needed all the support I could muster. Waddington could help from a distance, but on the spot at the time was visiting professor Richard Lewontin, an ardent supporter of the project, so I was fortunate in being able to have him accompany me to the vice chancellor. He greatly helped in making a persuasive case for this reorganisation. I recall the somewhat reluctant vice chancellor pleading that he wanted to know who his professor of botany was when some embassy official confronted him with a weed from the embassy’s garden for identification! Yet he agreed to the proposition of a school of biological science made from existing departments.
Sewall Wright was one of the founders of the modern evolutionary synthesis also known as neo-Darwinism. His contribution was largely theoretical and mathematical in contrast to that of Dobzhansky who combined experimental work both in the laboratory and the field. In some studies he collaborated with Dobzhansky. They wrote five papers together. Wright’s distinction as an evolutionary biologist is indicated by his being the only member of the zoology department in the University of Chicago with the title of Distinguished Service Professor. He published his first scientific paper at the age of 23 and his last when he was 99 in 1988, the year of his death. He also had the distinction of having published his first book *Evolution and the Genetics of Populations* at the age of nearly 80. It became a four-volume set within the decade 1968–78 and is now a classic. It was on one of his customary long walks that he slipped on the icy footpath and fractured his pelvis. He died a few days later from pulmonary embolism.

I came to know Sewall Wright when I spent a year in the
zoology department at the University of Chicago in 1946 and later at two symposia on science and philosophy in Bellagio, Italy. He was a quiet and unassuming scientist who had the reputation of being absent minded. He had the habit when lecturing (which I witnessed) of filling the blackboard with equations. As his right hand wrote the equations his left hand rubbed them out at the same rate. On one occasion it is said that he had in his pocket one of his experimental guinea pigs which he withdrew and absent-mindedly used as an eraser. He lectured from a pack of three-inch by five-inch cards which sometimes got muddled up. He was usually behind in his planned course of lectures. Near the end of the quarter, on his way to a class, he admitted that so far he had covered half the course and was giving the other half that day.

Of special interest to me was Sewall Wright’s philosophy of biology. In contrast to Dobzhansky and pretty well most other biologists he supported the concept of panpsychism or pansubjectivism. Most biologists think that mind in evolution arose from no-mind. At some stage in evolution mind appeared when it did not exist before. Wright argued that to believe that mind rose from no-mind is to believe in miracles. The property of mind must exist all down the line to, and including, the fundamental physical particles, a view which he got from the 19th century English philosopher WK Clifford via the English statistician Karl Pearson’s *The Grammar of Science* and later from Whitehead. Wright was saddened that his philosophical views received almost no attention from biologists. On the other hand it attracted some attention from philosophers and notably from a professor of philosophy in the University of Chicago, namely Charles Hartshorne. They became life-long friends. Hartshorne had a graduate student, who was working on pansubjectivism, with whom I had some discussions which resulted in my being
invited to see ‘Mr and Mrs Hartshorne at home June 5th 1946 from four to six 124 East 57th Street.’ So for me also began a life-long friendship with Charles and Dorothy Hartshorne.

Wright and Hartshorne recognised an outer and inner aspect of things. It is obvious that in addition to what others recognise in us as our outer aspects, such as the colour of our eyes, we are aware of an inner aspect (which represents our feelings or consciousness). This is the first-person view of ourselves. The third-person view of ourselves is what others observe about us. Pansubjectivism attributes an inner aspect not just to animals, but to the sequence of entities from fundamental particles to molecules to cells and so on to humans. Wright argued that whereas a previous generation saw an unbridgeable gap between supposedly non-living molecules and living cells this gap is being bridged by such entities as the gene. Wright then gives his arguments in which he regards the gene as like a living organism rather than an inanimate machine.

This turns on its head the traditional view that all the entities from quarks to humans are machines that have no inner or subjective aspect. In modern times René Descartes gave us this ‘Cartesian’ view of things. All these entities are machines. It is one thing to say that they are all like machines. It is quite another to say they are machines. The great advances of science have been made by supposing that the entities scientists study are like machines, for science studies the outer aspect of things. The heart in its aspect which the physiologist studies is like a pump. The brain and its mind is like a clock. Updating the metaphor from clocks to computers still utilises the machine analogy. In carrying out this program the scientist should not deceive himself or others into thinking that he is giving an account of all reality. The inner aspect of everything escapes him. Wright and Hartshorne
were concerned with how to include this inner aspect in a vision of reality. The classical physicist, for example, can only tell us that electrons repel one another according to a certain law. He says nothing about their real being and knows that he cannot. The discoverer of the electron JJ Thomson said that to know an electron you would have to be one. That expresses a view of the inner aspect of things which the modern quantum physicist is coming to recognise as, for example, in the work of David Bohm. Bohm argues that quantum theory undermines the assumption of mechanism. He distinguishes the outer aspects of nature, which classical physics studies as the explicate order, and the inner aspect of things as the implicate order. There is no thing in the universe. All is process. He anticipated that the first-person felt experience and the third-person description will both become part of an extended form of scientific method. While physics is moving away from mechanism, biology and psychology are moving closer to it. Such a position cannot last.

Bohm had a remarkable personality. I met him at two conferences on the philosophy of biology at the beautiful Villa Serbelloni at Bellagio on Lake Como under the auspices of the Rockefeller Foundation. The villa is more like a palace and a wonderful place to meet. Bohm was charismatic and self-giving with a wonderfully persuasive way of speaking. I have the most vivid memories of his community presence. His charm and originality eventually led to his becoming a guru, which was, in a way, inevitable.

There is a second reason why the picture the scientist draws of reality is partial. We are in a sense imprisoned in a way precisely expressed by physicist Werner Heisenberg’s famous remark that we do not see nature as it is, but only as a consequence of the questions we put to it.
Wright began his scientific career as a strict mechanist. This position was shaken when he read Henri Bergson’s *Creative Evolution*. Then came a famous dispute in Chicago between Jacques Loeb and HS Jennings on the interpretation of animal behaviour. Loeb was the arch mechanist who invented a mechanical insect that followed him with his torch around the lab. Loeb is portrayed as the mechanistic scientist Max Gottlieb in Sinclair Lewis’s novel *Arrowsmith*. Jennings suggested that if an Amoeba were the size of a dog we would attribute to it the sorts of feelings we attribute to a dog. Wright found himself somewhat in sympathy with Jennings’ position. However it was in AN Whitehead’s *Science and the Modern World* that Wright found the most complete philosophical development of the organic view of nature; Whitehead called it organic mechanism. I also became convinced of the organic view of nature through reading the same book.

So here we have in Sewall Wright and Dobzhansky two famous evolutionists with contrasting views on the nature of nature they investigated. One sees nature primarily in terms of mechanism with the non-mechanistic feature of mind emerging from no mentality somewhere in the evolution of the vertebrates. The other sees mentality as a central feature of all entities from humans down to quarks. One sees the world primarily as made of machines. The other sees the world primarily in terms of mental events. One is dualistic or materialistic. The other is monistic and non-materialistic. We shall try to give some reasons later on as to why most biologists (perhaps most people who think about it) are materialistic and believe that mind evolved from no mind. Cogent and detailed arguments in support of the view that mind cannot evolve from no mind are given by David Griffin (1998 p 64). More about this and its importance is discussed in Chapters 5 and 6. It is quite evident from the above that I learned a lot from Sewall
Wright about the concept of mentality as existing in some form all the way down to quarks. Why this is so important I pursue in Chapters 5 and 6.

Wilfred E Agar

Wilfred E Agar was the professor of zoology at the University of Melbourne from 1920 to 1948. He was a distinguished cell biologist, but is probably best known for his experiment with rats demonstrating that acquired characters are not inherited. As a first year student in 1936 I well recall his lectures on animal behaviour, a subject only then coming into prominence. As was the case with all professors in Australian universities at that time he hailed from England. Each department had just one professor who was known as the professor. Agar came from King’s College, Cambridge, and was a fellow of the Royal Society. I didn’t appreciate that he was deeply interested in the philosophy of biology until 1949 when he gave an address to science students on ‘Some philosophical problems in
biology’. I had at that stage read Whitehead’s *Science and the Modern World* so I was delighted to find in his address his Whiteheadian view of nature. He said that philosophical problems arise when refusing to regard oneself merely as an external spectator (the third-person point of view) of nature, one takes seriously the fact that each of us has a first-person view of nature through our feelings. One then asks: ‘How far from humans down the line is there subjectivity?’ In Agar’s view the universe is psycho-physical throughout.

Agar’s lecture was given at the University of Melbourne. So I wrote to him on behalf of the student Science Association in the University of Adelaide where I then was. We invited him to address students in Adelaide. I received from him a hand written letter dated 25 July 1949 which I have kept. He was unable to accept our invitation because of ill health. He said in part:

I was quite overwhelmed by your invitation … will you please convey my grateful thanks to the other signatories of the letter of invitation which I shall preserve among my most treasured possessions as the most cordial expression of good will I have ever received from my fellow biologists.

His letter made me realise for the first time that even the famous like to be appreciated. Even the great Darwin wrote in his autobiography that he wanted a ‘fair place among scientific men’.

I had been in touch with Agar earlier to ask him whom I should read on the philosophy of biology. He suggested Charles Hartshorne’s *The Philosophy and Psychology of Sensation* which began my renewed interest in Hartshorne. Much later Hartshorne wrote in *The Philosophy of Charles Hartshorne* vol XX ‘The Library of Living Philosophers’:
Although my book *The Philosophy and Psychology of Sensation* scored no great success in this country or in England: it achieved one success in Australia that was fortunate for me. It appealed to the professor of zoology at the University of Melbourne, WE Agar who convinced his student Charles Birch, that my book, as an application of Whitehead’s philosophy, was significant for biological theory.

Agar had also recommended to me his own forthcoming book modestly titled *A Contribution to the Theory of the Living Organism* (1943). Its first sentence reads ‘The main thesis of this book is that all living organisms are subjects.’ The characteristic of a subject is that it is a feeling or experiencing being. This is, to say the least, an unusual way of commencing a study of living organisms. Having established that all living organisms are like humans in this respect he then interpolates this view all the way down to atoms. In the process Agar deals with three big issues in biology: animal behaviour, development (embryology) and evolution. He seeks to show how Whitehead’s philosophy of organism and the notion of purpose is relevant to a proper understanding of these disciplines. A rather unkind review in the *Journal of Philosophy* by Ernest Nagel dampened somewhat interest in its reception. As with Agar’s exposition of his philosophy Hartshorne’s was also ignored by biologists except for his work on bird-song. It seems that adventurist philosophical physicists get a better reception from their colleagues than do adventurist biologists from theirs. One reason is that biology is still living in the age of mechanism as *de rigueur* whereas physics has been jolted out of simple mechanism by quantum physics.

In recent years molecular biologists have turned their attention to investigating consciousness or mind. The techniques for doing
this were unavailable in Agar’s day. Would he have been happy with their approach? So far as it goes perhaps, but it does not go far enough. It is fascinating to know in what regions of the brain we experience the colour red and what electrical impulses in the nerves are characteristic of this experience. They are what is called biological correlates of the experience. They are objective aspects of consciousness. The subjective aspects of experience still elude the investigator. How to overcome this problem is discussed later in this book. Agar established a strong case for trying to overcome this omission well ahead of his time. But it has yet to be taken up seriously by biologists. Agar’s thought greatly influenced my own and reinforced the conviction I was developing of the importance of the process thought of AN Whitehead for biology.