

## FROM DNA TO DEAN

by Arthur Peacocke

*Abstract.* In this broadly intellectual autobiographical essay, Arthur Peacocke describes how his educational background at Oxford led him eventually to physicochemical studies on DNA and other biological macromolecules and how biological complexity and the general problems it evokes have remained a recurring theme in his thought. He also describes how, although coming from a relatively nonecclesiastical background, this interest has nevertheless been intertwined with the larger questions to which the Christian faith seeks to respond. He outlines how he has been able to reconcile these two strands in his existence—even to becoming a priest-scientist and eventually the Dean of chapel of a Cambridge college. He reflects on the trends in the relation of religion and science over the last four decades and points to some hopeful developments in the relation between the two communities—and to some unanswered questions.

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Since we all start life as strands of the genetic material DNA, a percipient reader of the title of this autobiographical essay might assume that *E*, the letter added to *DNA* in the title's final word, can denote "everything else." This implicitly raises the question, Are we nothing but DNA? Or, to put it another way, Are we nothing but DNA's way of making more DNA? Or are we, on the other hand, *persons*—centers of self-consciousness, communicating by words and symbols our thoughts and feelings and intuitions, all of which are as real as DNA? Such questions cannot but dog the pathway of any

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trained and sensitive scientist concerned with the human condition. In my case, the attempt to respond to them has shaped not only my thinking but also my path through life.

First, then, the story is about me, as likewise about you: what we might call “The DNA Story”—the account of our origins, where we came from, and what we have inherited biologically, personally, and culturally.

I was young enough at the outbreak of war in 1939, and still young enough in 1942, not to be called into the armed forces. So, from a semisuburban, semi-industrial, semirural town some twenty miles northwest of London, then still on the edge of fine open English countryside, I went “up” (as we say) to Oxford with a scholarship in natural science to “read” (i.e., study) chemistry. My interest in the subject had been roused mainly through some first-class teaching I had received at my local “grammar school” where I had a non-fee-paying scholarship. At that time in England, these grammar schools were day schools, such as the one I went to, Watford Boys’ Grammar School, founded in the eighteenth century—and usually not well endowed. So they charged fees that were scaled down to nothing, according to means, for those who entered from the state schools of the country by competitive examination. That is the way I entered (earning, incidentally, my first academic award in the form of £5 for heading the county list, and so acquired a new bicycle that lasted me twenty years). My home was not at all bookish; my parents had left school at the ages of eleven and fourteen, but they were encouraging and enabling, and the local school provided as good an education as could have been found anywhere. The bombs were by that time falling, but the education persisted—disciplined and culturally broad, at the hands of men (and a few women) with first-class degrees from the best universities. I count myself lucky to have inherited a social system that was already providing such opportunities for those who did not come from academic, professional, or wealthy backgrounds.

By means of an “open scholarship,” again won by examination, I went to wartime Oxford, to a society that was light years away from my domestic milieu and already, under the impact of the war, very different from what it had been in the 1930s—from Evelyn Waugh and all that! The Oxford chemistry school at that time (in spite of Cambridge pretensions) had been for two decades preeminent in the country and outstanding in the world, vying with Harvard and Berkeley. The physical chemistry laboratory alone had five or six Fellows of the Royal Society among its ordinary lecturers, and there were almost as many in the other chemistry laboratories. It was there

I learned an essential lesson of academic life: that the professor, who in Britain is head of the department, is not necessarily the most intellectually distinguished person in the department. It took me a few more years to learn that this may also be true of the Fellows of the Royal Society! (Incidentally, the year following my entry into Oxford a Miss Margaret Roberts, who later married one Dennis Thatcher, also entered the chemistry courses. I didn't see much of her, although she could not fail to be noticeable for there were only about three women among the 180 chemistry students.)

The Oxford Final Honours School of Chemistry at that time probably offered the most specialized course ever devised by a university. It was a four-year course, entirely in chemistry, during the last year of which one did research and wrote a thesis, which was taken into account in assessing one's final class in the Honours School. Oxford chemists at that time prided themselves, not only on outstanding excellence in their subject (so they immodestly thought), but on being wide-ranging and catholic in their interests. So I did all the usual things: I played rugby football and rowed, listened to music and went to concerts, argued about philosophy and religion, and I was even once president of the English Club, entertaining such authors as Rebecca West and Dylan Thomas to dinner before they gave us their pearls of wisdom.

Physical chemistry appealed to me, and still does, because of its intellectual coherence and beauty—in particular, kinetics, thermodynamics, and quantum theory. In fact, when I look back over my varied teaching career I find I have never actually stopped teaching or writing about thermodynamics in some context or other. For example, my most recent scientific book, on the physical chemistry of biological organization, is concerned with the irreversible thermodynamics of biological processes (Peacocke 1983). The research I did for my first degree, and subsequently for a doctorate, was in the Oxford Physical Chemistry Laboratory, where I worked with Sir Cyril Hinshelwood. He was himself a polymath—one of those wide-ranging products of the Oxford chemistry school—who by then had received the Nobel Prize for his work on chemical kinetics. He was in the same year president of the Royal Society and president of the Classical Association; he spoke and read most European languages, including Russian, and he also spoke and read Chinese. When I joined his team, he had begun to apply his knowledge of chemical kinetics (the study of rates of chemical reactions) to the study of the processes of living organisms. I worked on the rate processes involved in the growth of bacteria and their inhibition by certain substances, for which I obtained my first doctorate (D. Phil.) at the age

of twenty-four, so intensive was the educational process in England then (and still is, for those who get that far).

I then took a post in the University of Birmingham, and in 1948 married the sister of a college friend—*very* conventional, one might say, but it has lasted for over forty-three years! In those days one did not usually marry until one had a job—or have children until one was married! We had, in fact, two: a son in 1950, now Waynflete Professor of Metaphysical Philosophy at Oxford and married to an American barrister, and a daughter in 1953, now a deacon in the Church of England, head of religious education in a state secondary school, mother of three, and married to an *Alttestamentler*, who is also a scholar of the Dead Sea Scrolls.

In my eleven years at Birmingham, where I was promoted from assistant lecturer to senior lecturer, I worked on something that had begun to interest me, namely the physical chemistry of DNA molecules. DNA in the late 1940s and early 1950s was only just becoming to be seen as a very big molecule. There was some challenging physical chemistry to be done in relation to this extraordinary structure, and I was able to engage in it with the simplest of equipment (e.g., a pH meter) but with a maximum of intellectual challenge. In 1952 I was in Berkeley on a Rockefeller Fellowship, at the famous Virus Laboratory headed by W. M. Stanley (of tobacco mosaic virus fame), when James Watson and Francis Crick announced the structure of DNA in the British journal *Nature*. Doing primarily physicochemical work on DNA with results of some interest to the others (we were able to ascertain that the chains in DNA were not branched and that the hydrogen bonding proposed by Watson and Crick was the only kind in the structure), I came in close contact with those working on X-ray diffraction, the circles interacting with Watson and Crick. Fortunately, I was not so emotionally involved as the X-ray people in the events that swirled around that momentous discovery in the history of biology.

For example, I remember being at an informal conference in 1953 in a small town in the middle of France, where a French scientist had his country house and had invited a dozen or so scientists to discuss the implications of the newly discovered DNA structure, and I was contributing the results of my physicochemical work. Also in that country house were three Nobel laureates-to-be who were scarcely on speaking terms with each other—but I won't elaborate on that. (Everyone knows something of the saga from the plethora of books that have been written about that fascinating episode in science, beginning with James Watson's *The Double Helix*.)

My scientific career flourished; I went back to Oxford to a

fellowship and a lectureship; and there I continued to teach physical chemistry and do research in physical biochemistry. I also pursued research into wider aspects of the physical chemistry of biological macromolecules. After twenty-four years of such work I had written some 120 papers, was running a research group with ten or twelve postgraduates and postdoctoral students, and so on. Then, at the age of forty-eight, the Oxford scientist became a Cambridge “Dean,” the name given to the person in charge of a Cambridge college chapel—Clare College, in my case. How did this happen and why? In some ways Cambridge was, I suppose, the last place I expected to find myself.

So now I must tell the other story, running along all the time, parallel and intertwined with the one I have just told, like the two complementary chains of DNA.

I was brought up in a typical Church of England household—typical in the sense that the established Church of England was the church my family stayed away from, except for baptisms, weddings, and funerals. I was sent to Sunday school at a local church whose “high” style of worship was disapproved of by my family (presumably it was thought to be too florid and un-English in its excesses), and later I went voluntarily to a “lower,” “evangelical” church, in which I was confirmed (the completion of the rite of baptism for a young Christian). Adolescent schoolboy evangelical fervor soon gave way to a mild undergraduate agnosticism that I shared with most of my contemporaries. Yet we all went to college chapel (indeed, scholars of my college, Exeter, *had* to go, being “on the Foundation”). It was also the accepted convention; it was what most members of the college did on a Sunday evening: everybody went to chapel, went to “dinner in Hall,” had a glass of beer, and then went into the main dining hall for music or for poetry or play readings. (I was at the same college as Neville Coghill, later famous for his translations and productions of Chaucer’s *Canterbury Tales*, and this had a lot to do with the cultural quality of our wartime college life. [Perhaps I should add that Richard Burton was also a contemporary, a pupil of Coghill.] )

Religious and philosophical questions continuously crossed my mind. I rejected biblical literalism as naive, as well as the penal/substitutionary theory of atonement (which I thought unintelligible and immoral, and still do). The urging of such views by evangelical, “born-again” Christians in my undergraduate days was the chief cause of my alienation from all things religious, Christianity in particular, and of the temporary end of my attachment to the Christian faith. It took me some time to find out that other ways of

thinking were possible for Christian believers. One of the turning points was hearing a sermon in the University Church by William Temple, who was Archbishop of Canterbury and the most considerable philosopher-theologian to hold that office since Anselm. I came away aware, as I had never been before, that a *reasonable* case could be made for Christian belief and that, although I still did not embrace it, it was an intellectually defensible and respectable position. So the door was reopened.

When I was a graduate student, doing the scientific research I have described, questions kept pressing on me, sharpened and made more urgent by the faith of Rosemary, my wife-to-be. How *could* one explain and account for what every scientific advance unveiled and reinforced, namely, the inherent intelligibility and rationality of the natural world? Both the *fact* of its existence (the answer to the question one asks, Why is there anything at all?) and the manifest rationality of the natural world seemed to demand some kind of theistic affirmation to make any coherent sense of it all—and making sense of a wide range of data was just what my training and research were making my habitual intellectual practice. So the God-idea, you might say, pursued me, and my experience echoed that of the famous first lines of Francis Thompson's *The Hound of Heaven*:

I fled Him, down the nights and down the days;  
 I fled Him, down the arches of the years:  
 I fled Him, down the labyrinthine ways  
 Of my own mind

Now the data, then and now, that we need to put into some sort of pattern include human beings, with all their sublime achievements but also with all their degradations. By this time, in the late 1940s, my generation had seen, if only in film and photograph, what the Allied forces had uncovered in Dachau, Auschwitz, and Belsen. We had looked into the bottomless pit of the potentiality of human evil, which the twentieth century has seen escalate perhaps more than in any other century.

I tried, in my own way, to come to grips with the problem of evil. A full intellectual solution may always elude one, though I am now able to narrow down and specify the problem better. It certainly became clearer, then, and still seems to me valid, that even if the existence of evil raises baffling intellectual questions, and it certainly does, we have been shown how evil is to be *overcome* in reality and not just in theory. Dimly I began to perceive what is sublimely expressed in the concluding stanza of Dante's *Paradiso*, where Dante describes his vision of God:

High phantasy lost power and here broke off;  
 Yet, as a wheel moves smoothly, free from jars,  
 My will and my desire were turned by love,  
 The love that moves the sun and the other stars.

It is *love* that overcomes evil—and here is the nub of it—and the one Creator God, whose existence as supreme rationality I had perforce begun to recognize, was also, it became clearer, the One whose character is least misleadingly described as Love and whose outgoing activity is an expression of that same nature that shines through the life, death, and resurrection of Jesus the Christ. So my quest proceeded. Looking back at my time as a graduate student, I am amazed at how arrogantly I assumed I could learn little from the wise minds within half a mile of me. So I plowed my own furrow and read my own books, without asking any of the learned people around me what they thought about these things. Perhaps one has to make one's own way; however meandering, it will always be one's own, and maybe there are no shortcuts.

In Birmingham, I rapidly became disenchanted by the content of most sermons I heard and by the poverty of nonliturgical worship. Thus it was that I undertook more systematic study and even managed to get a degree in theology. I was deeply influenced (and still am) by the writings of judiciously reasonable theologians—William Temple, Charles Raven, Ian Ramsey, Geoffrey Lampe. I could not then and do not now—here my formation (my *Bildung*) as a scientist comes out—accept any “automatic” authority of church or scripture *per se*. For me, belief must meet the general criteria of reasonableness, of inference to the best explanation. This is still my position, although it is coupled with a growing awareness of our dependence on the earliest witnesses to Jesus as the Christ and of our need to sit at the feet of the men and women of God of all ages, traditions, and religions.

I was relieved to find that the Church of England (our part of the Anglican Communion) was theologically, philosophically, and intellectually a very *broad* church, providing the space in which to move and grow, feeding, as it does, on both Catholic and Reformed traditions and much influenced by the Eastern Orthodox churches. It has long had the habit of emphasizing the role in the formation of a secure and stable faith of reason, based on experience in sifting both scripture and tradition. Its reliance on this “three-legged stool” of scripture-tradition-reason could be its special, distinctive feature. (The biblically and ecclesiastically conservative, although found within its ranks, are more explicitly and homogenously to be found in other churches.)

It is instructive in this connection, and in view of my personal synthesis of science and religion, to read what the first historian of the Royal Society (our premier scientific body) wrote in 1667 about the relation of church and science, the new natural philosophy. Remember, the Royal Society had only been founded a few years before, almost concurrently with the restoration of the Book of Common Prayer and the Church of England, after the Commonwealth had abolished them. This historian, Thomas Sprat, wrote:

We behold the agreement that is between the present *Design* of the *Royal Society*, and that of our *Church* [of England] in its beginning. They both may lay equal claim to the word *Reformation*; the one having compassed it in *Religion*, the other purposing it in *Philosophy*. They both have taken a like course to bring this about; each of them referring themselves to the perfect *Originals* for their instruction; the one to the Scripture, the other to the large Volume of the *Creatures*. . . . They both suppose alike, that their *Ancestors* might err; and yet retain a sufficient reverence for them. . . . The *Church of England* therefore may justly be styl'd *Mother* of this sort of *Knowledge*; and so the care of its *nourishment* and prosperity peculiarly lyes upon it (Sprat 1702, 370–72).

Supposing our “ancestors might err” and yet retaining a “sufficient reverence for them” seems to me just the right balance between dogmatic traditionalism, on the one hand, and destructive radicalism, on the other. So I count myself fortunate that, at that stage of my quest, I had the chance of pursuing it within the ranks of a Christian church that is the reformed and the catholic church of my people—one that allowed, and still allows, the habit of open inquiry into the reasonableness of faith in the light of modern (in my case scientific) knowledge.

Theological study showed me something I had *not* expected as a hard-line scientist, namely, that the Christian Church throughout the ages, behind its shifting and variable facade, has a very tough-minded intellectual tradition of its own, which makes the content of its thought a worthy and proper subject of university study (the message I had begun to receive in that sermon of William Temple). Figures like Saint Paul, Origen, Gregory of Nyssa, Augustine, Anselm, Aquinas—among many others—are intellectual giants and simply cannot be ignored by any twentieth-century seeker after intelligibility and meaning.

Naturally, I always found myself relating my scientific worldview to theological perspectives. I found I could not ignore the continuity and interchange in the human being between the physical, the mental, the aesthetic, and the spiritual—those activities and the knowledge we gain from them, all modes of our being persons. And all have a *real* reference. In theology, this meant I would place (and



still do) a strong emphasis on the *sacramental* (which is, in theology, the bond that unites the physical, the mental, the aesthetic, and the spiritual). I had for some ten years or so been what the Church of England calls a "Lay Reader" and so had been authorized to conduct nonsacramental public worship and to preach. But this increasingly felt like trying to walk on one leg, especially as the synthesis of the scientific and Christian aspects of my life and thinking were occurring increasingly through the sacraments and the sacramental aspects of all of life. This meant I experienced a growing urge to celebrate sacramentally our unitary awareness of nature, humanity, and God.

Some years before, at Birmingham, I had begun to think of ordination to the priesthood as a worker-priest—that is, in my case, a priest-scientist—but the move back to Oxford had put that thought aside. After some ups and downs professionally, and some twelve years after beginning to think of it, I was ordained, first to the diaconate and then to the priesthood in Christ Church Cathedral, Oxford—where, it so happens, I officiate now as an honorary chaplain.

I shared, and still share, all the average Englishman's conditioned reflexes toward, and suspicions of, the clergy as a class; so I was glad to become a priest, but had no intention then, and still haven't (I hope I have avoided it), of becoming a "clergyman." Fortunately, this attitude coincided with the outlook of the enlightened Bishop of Oxford (Kenneth Woolcombe), who ordained me to what was called the "title" of my Oxford college fellowship—a legal relic from the medieval church whereby an Oxford or Cambridge college fellowship was ipso facto regarded as a "cure of souls," that is, a pastoral charge (a salutary reminder to twentieth-century university professors?).

After ordination, I intended to continue as a worker-priest, as a university research worker and teacher in priest's orders, doing my job with and alongside everyone else. And so I have always regarded myself. I would have stayed at Oxford except that Clare College, Cambridge, was looking for a dean and offered me the post. I liked the idea of running a college chapel that could be flexible and open, yet transmitting and educating a new generation in the incomparable liturgies and musical heritage not only of the Church of England but of the universal—that is, of course the catholic—Church. Also, I liked the idea of a post that would allow me what no university faculty structure could: to work on the interface between science and theology. (Somehow, I have always tended to live on boundaries—even in science I was between physical chemistry and biology—but this was a much longer boundary).

My decision to go to Cambridge was not easy. Not only did I know from bitter experience how much I would feel the wrench of departure from Oxford which had nurtured me, but the decision was complicated by an essentially twentieth-century problem. I was half of a two-career family. My wife, Rosemary, who was a teacher, had become head teacher and then, after a few years, one of the H. M. Inspectors of Schools—a unique British institution. These inspectors, who form an independent body, monitor the nation's standards of education and report directly to the secretary of state for education. When the offer came from Cambridge, my wife had her area of responsibility around Oxford—and Cambridge was some three hours' drive away. So we faced the perennial problem of the two-career family. I did not decide to accept the invitation from Clare College until she had been assured that she could continue in the inspectorate, working from Cambridge.

Thus it was that for eleven years I taught in the Cambridge divinity faculty on the interaction of science and theology, as well as physical biochemistry in the biochemistry department. Anyone who has tried to jump faculty boundary lines will realize how exceptional this was, certainly in Britain. Only a university that is both a corporate entity and, constitutionally, a federation of independent colleges (as are, almost uniquely, Oxford and Cambridge) could have afforded me such a possibility. Furthermore, Oxford man though I am, I gladly acknowledge the opportunities of intellectual freedom that Clare College, Cambridge, gave me to explore in depth the issues that arise for the Christian faith in a scientific age—at the same time sharing in a culturally rich environment. In this latter respect, the college had (and still has) a superb choir whose music enriched the chapel worship and the general life of the college. (Music has been a major source of inspiration to me throughout my life.)

Although Cambridge gave me the time (and salary) to pursue my studies on the science and religion interface, Oxford provided the goad, in the form of an invitation to deliver the 1978 Bampton Lectures. The Bampton Lecturer is appointed by the heads of Oxford colleges, an almost totally lay (and largely agnostic) body, and not by theologians, although the eighteenth-century testator, John Bampton, a canon of Salisbury Cathedral, had prescribed that the lecturer “confirm and establish the Christian faith” and “confute all heretics and schismatics,” and that he should not be paid a penny until the lectures had appeared *in print*. (Clearly, Bampton was as shrewd as he was philanthropic.) These lectures constituted a major challenge, especially as the only other twentieth-century attempt to relate science and religion in this series had been by Dr. Eric Mascall

from a neo-Thomist viewpoint over twenty years previously. In 1979 the lectures were published (and I was paid), and they were well received, especially in the United States (Peacocke 1979). But as a German reviewer noted, they displayed the Anglo-Saxon propensity of not describing one's methodology and metaphysics before undertaking such a task of reconciliation between disciplines. It was true that, like any empiricist or working scientist, I had waded into the problems, thinking of ways to tackle them only *ambulando* and not on the basis of any predetermined procedure or formula.

Those lectures nevertheless contained (in a couple of pages) an outline of my epistemological stance, of a skeptical or qualified realism, and I expounded this outlook (more definitively labeled "critical realism," with respect to both science and theology) in my 1983 Meldenhall Lectures at DePauw University (Peacocke 1984). This stance is characterized by the conviction that in both science and theology we are trying to depict reality through revisable metaphors and models within the context of a continuous linguistic community. This view is widely held and well supported—I am not suggesting I invented it—as an interpretation of what *science* is doing and affirming, but still needs to be established for *theology* against the tides of religious fideism, fundamentalism, and conservatism, which seek to overwhelm the establishing of a reasonable faith that would be plausible and believable in a cultural world dominated by the sciences. However, I cannot but think that time is on the side of critical realism in theology, because most believers in God would give up their faith if they did not think that their models and metaphors referred to and were attempting to depict the circumambient Reality that is God—just as the scientist would not endure the trials and tribulations of research if he or she did not think they were probing into a *real* natural world. Moreover, as regards the "critical" qualification of "critical realism," it is becoming clear that one cannot ascertain truth in theology and religion merely by appeals to the authority of sacred books or traditions, for it is simply circular argumentation for these to try to validate themselves. They cannot be self-authenticating. Their affirmations cannot avoid being judged by reason based on experience—that is, "critically."

During my time in Cambridge I learned something about which I had not previously been totally aware—namely, that the scientific "me" could not be fully absorbed (without remainder) into the priest, even into the priest working on the relation of science and faith. Thus it was that, because I was free from faculty pressure to publish scientific papers, I was able to explore widely, in a way I was not able to do while heading a research group, into new

developments, some still speculative, in physicochemical theory that were beginning to look exceedingly promising. These developments pertained to the interpretation of the baffling complexity of living organisms and their intricate processes. This eventually—although it was a long haul, taking ten years—resulted in the monograph on the physical chemistry of biological organization (Peacocke 1983). It brought together many previously unconnected developments in mathematics, kinetics, and thermodynamics, and, I hope, contributed to our understanding of the wonder of biological complexity in the natural world.

There is a time for everything under the sun, and my days in Cambridge came to an end somewhat sooner than they had to so that I could return to Oxford at the end of 1984 to set up the Ian Ramsey Centre, at St. Cross College, for the interdisciplinary study of ethical problems arising from scientific and medical research and practice, as well as the underlying philosophical and theological issues. This project had been gestating for over twenty years, ever since Ian Ramsey, who was known for his pioneering work in the philosophy of religion and especially for his analysis of religious language, and who eventually became Bishop of Durham, had brought together (in a sermon before the University of Oxford) the concerns of many in the early 1960s about the need for Christian theology to cooperate with other disciplines in facing up to the ethical questions that arose from new applications of science, medicine, and technology (Ramsey 1964). The fruits of that enterprise are only now beginning to be harvested.<sup>1</sup> The Centre continues under a new director, Caroline Miles, for I relinquished that responsibility in August 1988 to find time for my writing and for another enterprise. Unfortunately, the Ian Ramsey Centre is in dire need of funds to maintain its infrastructure—although there is no lack of projects on which to work.

Before I come to my concluding reflections, I would like to recount another dimension of my concerns over the years. No one who works on the interface between science and religion can be unaware of the social dimension of this interaction; the *communities* of those engaged in the scientific and theological enterprises are estranged and alienated, and each goes its own way, regardless of the other. Over the years, I have been able to play some part in breaking this silence, of crossing this “no-man’s-land” between the two groups, which still see themselves as opposing armies because of false mythologies of what happened in the nineteenth (and earlier) centuries. In the early 1970s I started informal consultations in Britain between scientists, theologians, and clergy who were concerned to relate their scientific knowledge and methods of study to their religious faith and practice.

This small group grew in numbers as it faced these increasingly complex issues, and in 1975 the Science and Religion Forum was formally inaugurated at Durham. It has been meeting annually and publishing its deliberations and reviews of relevant books ever since. Smaller groups, concerned with similar themes, were coming into existence in other parts of Europe, and at the 1983 IRAS Star Island conference in New Hampshire, it became apparent that both in the United States and in Europe wider groupings needed to be convened. In response to this, encouraged by Karl Schmitz-Moormann, I organized an initial exploratory consultation in September 1984 at Clare College, Cambridge, where I was still Dean. The first European conference on science and religion was held at the Evangelische Akademie, at Loccum in the Federal Republic of Germany, on "Evolution and Creation" (*not* on "creationism," which appeared in our deliberations only through its rejection). (The proceedings were published as Andersen and Peacocke 1987.) There was a second European conference in 1988 (the proceedings were published as Fennema and Paul 1990), and at the third in Geneva in 1990, the European Society for the Study of Science and Theology was formally inaugurated. All of this is immensely encouraging and of great significance for the future of religion in general and of Christianity in particular in Western society.

Much of what I have said has been at the level of the head, but the heart too has its reasons. Indeed, for more than 30 years I had been intuiting and discerning that a purely intellectual dialogue between those engaged in the scientific and theological enterprises was not enough, for theology (*theo-logy*) is *ex hypothesi* concerned with words about God—and words restrict and confine. God is in "the still small voice" and in the silences that follow louder, more articulate exercises. Theo-logy cannot itself be the experience of God, who is known through life in prayer, in worship, and in silence. Furthermore, I saw that the Church needs not only intellectual inquiry of the kind stimulated by the bodies I described, but a cadre of committed and informed members who constitute a new kind of "Dominican" order, held together by prayer and sacrament, and committed to the life of science for and on behalf of the Church: to represent the Church in science and science in the Church. So it was that in 1987 there was founded, initially within the Anglican Communion, and specifically the Church of England, a new, dispersed Order, The Society of Ordained Scientists (S. O. Sc.), bound together by a Rule of prayer and sacrament, to which we are committed through appropriate vows made at a Eucharist presided over by the Archbishop of York (Dr. John Habgood), who is our Visitor (and was himself a

research physiologist). We have two women deacon-scientists (women priest-scientists hopefully to come!) and ministers of the United Reformed, Methodist, and Presbyterian churches; we are also international, with four members in the United States (three Episcopalians and one member of the United Church of Christ) and one in Canada. As the warden of this fledgling Order, I see its future as wide open and as having great potential for the Church (we have already been able to be a useful resource for it in a number of ways); and as having expanding ecumenical possibilities, for example, with that newly formed body, Jesuits in Science. I conclude with some reflections prompted by this retrospect on my life, stimulated by this very tempting invitation to be loquacious about myself and my life, which has always been spent on borderlines, whether of physics/chemistry, physical chemistry/biochemistry, and science/theology.

First of all, *Christian belief*, or indeed any religious belief, it seems to me, will confine itself to an intellectual and cultural ghetto unless it relates its affirmations to the best knowledge we have of the world around us (and that includes the human world). This is a perennial challenge to Christian theology and to all religious belief, although at certain times in the past Christian thinkers have responded to such challenges superbly and creatively. The problem today is that few theologians and students of the humanities have any inkling of the breadth and depth of the scientific worldview, partly because of the extraordinary narrowness of most education systems, and notably the British (at least until changes in the new national curriculum have their effect). The amount of general education to be done everywhere is immense.

Of course, myriads of questions still arise, such as

the nature and destiny of human beings in the light of their evolutionary origins;  
 human needs and potentialities in the light of new knowledge from psychology and physiology;  
 our attitudes to and our control over nature;  
 how to talk about God in the light of the increasing likelihood that the universe seems to have in-built self-creative potentialities.

Such issues, and many others, cannot be ducked—and they will not “just go away.”

Second, the *sciences*, through their range and diversity, now afford a perspective on the world whose full emotional and poetic force could only be conveyed by a twentieth-century Dante. This perspective sharpens the questions we ask about personal meaning and

intelligibility. For example, science sharpens the question, What kind of universe is it that the original fluctuation in a quantum field, the primeval mass of baryons and quarks and neutrinos and light quanta, could over aeons of time by their own in-built potentiality and form, develop into human beings who espouse values (e.g., truth, beauty, goodness) and could become a Mozart, an Einstein—or Jesus of Nazareth?

Third, the *relation of science to theology* is just one of the problems of the relations of many disciplines and forms of knowledge to each other. Thus, we need a new map of knowledge. Science shows that the natural world is a hierarchy of levels of complexity, each operating at its own level, requiring its own methods of study, and developing its own conceptual framework, and so its own science. I therefore affirm that atoms and molecules are not *more* real than cells or populations of cells, or human communities, or human persons; there are *social* and *personal* facts; just as there are physical and biochemical ones. In my view, the relation of these different levels should not be what has been called “nothing buttery,” that is, *reductionism*. Biology is *not* “nothing but” physics and chemistry; neurophysiology is *not* “nothing but” biochemistry; psychology is *not* “nothing but” neurophysiology; sociology is *not* “nothing but” biology. All the way up the hierarchy we see “takeover bids” by the level below with respect to the level above. Again, however, each level refers to only one aspect of reality, and we need explicitly to understand the nonexclusive relations they bear to each other.

Furthermore, both the scientific and the theological enterprise involve *exploration* into the nature of reality, which comes as no surprise to those who study science. However, very few people these days (notably politicians in Britain, who use the word *theology* pejoratively) seem to regard the theological enterprise as an exploration into the nature of reality. But that, of course, is what it is—as splendidly expressed in the opening sentence of the 1976 report of the Doctrine Commission of the Church of England (of which I was a member) on Christian believing: “Christian life [I would add life in all religions] is an adventure, a voyage of discovery, a journey, sustained by faith and hope, towards a final and complete communion with Love at the heart of all things.”

Let me not pretend that in my explorations I have arrived anywhere very significant, nor indeed have many of us. There is a mystery at the heart of things which requires not only all the data to be assembled and none to be dismissed, but also the most intensive application of mind and heart and will to penetrate. As a scientist, the great Newton recognized that, if he had seen farther than others,

it was because he stood on the shoulders of giants. This is as true for religion as it is for science, and yet we also need to be reminded of that shrewd remark of Newton's great successor, Einstein, that "science without religion is lame, religion without science is blind."

Throughout my life, one of my joys, consolations, and spiritual adventures has been music. As scientists, we might even say that we are listening to the music of creation, to the work of God the Creator-Innovator. Again, as Newton put it, we are "thinking God's thoughts after him." For me, this has been expressed in a uniquely evocative manner by Johannes Kepler, the astronomer and mystic, one of the giants on whose shoulders Newton stood:

The heavenly motions are nothing but a kind of perennial concert, rational rather than audible or vocal. . . . Thus there is no marvel greater or more sublime than the rules of singing in harmony together in several parts . . . so that, through the skilful symphony of many voices, he [man] should actually conjure up in a short part of an hour the vision of the world's total perpetuity in time; and that, in the sweetest sense of bliss enjoyed through Music, the echo of God, he should almost reach the contentment which God the Maker had in His Own works (Popper 1976, 59).

So it is that the modern scientist also hears "the echo of God" in the music of creation with a range of insights that must evoke not only an even greater wonder than that of a Kepler or a Newton but also a more profound humility at the intricate, flexible, and ever-new openness of all this marvelous world to which God the Creator gives existence and which is our earthly home.

## NOTES

1. In a publication exploring widely disparate conceptions of the nature of the human "person" (Peacocke and Gillett 1987); and interdisciplinary reports with individual essays, including *Values, Conflict and the Environment* and (in press) *Medical Decision Making and the Concept of "Quality of Life."*

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